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AVIATION

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Target Range for Light Rays...

DESIGNING the optical system for a modern sextant, octant, driftmeter or bombsight... is a complex mathematical undertaking. Computing the numerous lenses alone is the work of months and often years! Proof of the computation lies in "shooting" light rays through prototype lenses to targets set at exactly prescribed angles.

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PIONEER INSTRUMENTS

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Briefing for October

The postwar plane market has been envisioned in terms ranging from super-gloomy to super-glowing. Most estimates are offhand and decidedly off-base. Let's be Practical About Postwar Plane Markets, Page 114, is a hardheaded analysis of aircraft requirements based on a realistic appraisal of aviation facilities and aircraft capabilities.

Thorough engineering generally precedes thorough sales activity of a truly useful product. This applies to helicopters—but with the 'copter it appears that the cart is being put before the horse. There are many engineering problems ahead. The answer to What is the Helicopter's True Commercial Future? depends on a proper balance and sequence between these factors. See Page 116.

Properly coordinated, the "know how" of plane manufacturer and operator is bound to result in better airplanes and better operations. Douglas has made full provision for this merger of ideas through its service department, and the results are spectacular. How this service organization is set up and how it functions is described on Page 120.

AAF mobile repair units roam the English countryside on "missions" involving the repair of forced-down bombers and fighters returning from combat missions. See Page 124 for complete details on how the "mobiles" work.

The first article ever published on maintenance and repair of Navy blimps begins on Page 128. This unique story is illustrated with some of the finest photographs we have seen in a long while, and the maintenance procedures are described in detail.

A very considerable portion of the activities of airline engineering departments involves teamwork with the maintenance department. How superior operating results are obtained from this liaison at American Airlines is described in detail (Page 136).

At the AAF's School of Applied Tactics in Orlando, Fla., maintenance men prepare for overseas assignments by servicing aircraft under simulated combat conditions. The conditions under which they train are related in our Page 138 feature.

Ingenious tool design and logical arrangement of facilities have resulted in a daily saving of 40 to 50 man-hours at the Jacksonville Naval Air Station. For sketches and description of these tools, turn to Page 142.

The airlines have always maintained an enviable reputation for reliability, and this year they have achieved the impossible by keeping up their excellent record despite manpower and equipment shortages. On top of all this, the Army moved in and the airlines took over this additional maintenance. Announcement of AVIATION's annual Maintenance Award is made on Page 118.

Curtiss Propeller overseas service men either make their battle-damaged airscrews useful again, or junk them. But it's seldom the latter, as our revealing "how they fix 'em" article proves (Page 144).

There is plenty of incentive incorporated in the RCAF system of maintenance—through an established competitive spirit among the crews (Page 148). Covered are the system and results.

When the war suddenly sent *Ranger* engines all over the world, there was a brand new service problem to lick. Our article (Page 151) relates the successful way the company met this problem.

With a frozen pond for a hangar deck and clouds for a roof, CPA services the planes of its "bush" lines. The elasticity of the system meets all emergencies (Page 154).

In Watch Your Tires (Page 156), a manufacturer explains why even good rubber may survive only two landings and tells what to do about it.

George W. Brady of the Curtiss-Wright Propeller Division believes the time to test engine horsepower is when it is flying, and he proves his point (Page 179).

When cowl flap trouble developed at Continental Air Lines, Messrs. Durham and Peters got busy. Their very effective method of overcoming the difficulties is described on Page 147.

Smooth flying often is made difficult if not impossible by slackness or creeping in the control system. Now, however, a new cable has been developed to curb this trouble. For details, see the article on Page 189.

How the small businessman may survive both the war and peace is set forth in the timely article, Don't Sell the Fixed Base Operator Short (Page 226).

Down the Years in AVIATION'S Log

25 Yr. Ago (1918)—L-W-F fighter biplane carrying seven machine guns and four bombs climbs to 10,000 ft ceiling in 7½ min. . . . NC-1 flies from N. Y. to Anacostia with 15 passengers. . . . Handley-Page plane carries 40 passengers in England, doubling previous record. . . . Government reserves large tract of airplane spruce in Alaska. . . . Boeing installs 4 ft. wind tunnel with 9 ft. propeller at U. of W. . . . Navy requests funds for four Zeppelin-type airships at $1,500,000 each. . . . Army offers P.O. 100 *Liberty*-engined DH-4's for airmail use.

15 Yr. Ago (1928)—N. Y. Dock Commissioner announces that work will soon start on Floyd Bennett Field . . . Braniff Air Lines, operating between Tulsa and Oklahoma City, announces that operations will be extended into Texas after Jan. 1. . . . Mercedes-Benz puts out 12-cyl. 1,000-hp. engine. . . . Persia (Iran) permits airlines to fly across country. . . . Rep. Kelly (Pa.) offers joint House resolution favoring aviation reciprocity with foreign countries. . . . Louisville manufacturer ships three planeloads of cigarettes to N.Y. by airmail for $2,600 postage.

10 Yr. Ago (1933)—Department of Commerce investigates possibility of $700 plane. . . . Mayor of Newark, N. J., asks government to take over city airport. . . . Fourteen Soviet engineers start training course at Wright factory. . . . Lt. Comdr. T. G. W. Settle, USN, and Maj. Chester L. Fordney, MC, ascend 61,237 ft. in a free balloon, breaking record. . . . PAA and Imperial Airways discuss N.Y.-Bermuda route. . . . Marine Corps Squadron 7M wins Herbert Schiff Trophy by flying 3,517 hr. without accident.

Teamwork Made America First in the Air!

THE urgency of creating our great Allied air armadas required a production capacity many times that of America's aviation industry. So it invited thousands of manufacturers in many fields to "team up" in the vast program of making America *first* in the air.

Kollsman joined in this effort by "schooling" over a score of manufacturers in the difficult techniques of building complete Kollsman aircraft instruments.

Kollsman immediately threw open its facilities to the engineers of coöperating plants. Step by step, Kollsman engineers revealed to them in minute detail the intricate techniques of mass-producing these vital precision products. And then they frequently went into those plants and helped work out production . . . and kept at it until the last "bug" was ironed out.

It isn't easy to build instruments that meet Kollsman specifications. But our "team" is doing just that . . . and in ever-increasing volume. While this work goes forward, Kollsman is busy at the task of developing aircraft instruments to meet new flight problems.

THE KOLLSMAN 50,000 FT. SENSITIVE ALTIMETER *is so ingeniously geared that a diaphragm expansion of only three-sixteenths of an inch sends the pointer around the dial 50 times! Capable of measuring altitude to within a few feet, its essential parts are finished to within two ten-thousandths of an inch.*

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Free Enterprise

THE OPPORTUNITY AND OBLIGATION TO COMPETE

☆

WE can be prosperous beyond our dreams—all of us—workers, farmers, and business men—but one of the prerequisites is the self-discipline of accepting competition for ourselves as well as others.

* * *

Free enterprise does not imply the freedom to use any or all means to make a profit. It does not mean the right to monopolize. ***It means the opportunity and obligation to compete.***

Competition requires ***independence of action, free access to the market,*** and ***no large degree of control over the price*** by any buyer or seller. In general, the larger the number of sellers and the more easily buyers can shift from one seller to another, the higher will be the degree of competition (and vice versa for buyers).

But let us not get too academic or go off the deep end. We cannot have perfect competition. We cannot subdivide businesses and labor unions into tiny units to make a multitude of buyers and sellers in each market; we cannot reduce our rich variety of products to a few rigidly standardized items; we cannot educate people to judge quality precisely; we cannot eliminate the costs of bridging space between buyers and sellers. On the other hand, have we gone as far as is practical and desirable in these directions?

We cannot even have a system of highly "sensitive" prices, that is, prices which fluctuate immediately in response to every minor change in demand and supply. This would occur in the dream world of competition-to-the-nth-degree. It cannot occur in the real world, or even in the ideal world of competition best suited to physical facts and human qualities. The economies of large-scale enterprise, the need for adapting products to human wants, the costs of transportation and the costs of issuing and acquiring market information put severe limits on price sensitivity.

Economists tell us that if prices were extremely sensitive, business booms and depressions would be much less severe—provided our stock of money remained fairly constant. But with the somewhat limited degree of sensitivity which is practicable in the economy, price and wage changes cannot prevent severe declines in business activity. ***We cannot count on competition alone to cure depressions.*** We must look mainly to other kinds of measures to prevent mass unemployment of men and machines.

If we cannot have prices which fluctuate with every small change in demand and supply conditions, we can work toward—and achieve, if we really want it—a system in which prices and wages are at least roughly responsive to long-run changes in demand and supply, a system in which most markets are not dominated by individual businesses, groups of businesses, labor unions, or farm organizations, and in which prices and wages are maintained at levels consistent with free access to markets and to jobs.

In any kind of an economic system there must be some means of determining prices, wages, and profits, and of bringing labor and capital into employment in the industry and place where they are most needed. There are two ways to do this: by administrative fiat or by the impersonal processes of the market. The first of these is typical of the totalitarian state; it frequently involves destruction of individual freedom or fumbling mismanagement. During the war all of us have had some experience with patronizing and paternalistic treatment by the state; we have found out what it means to be pushed around by bureaucrats; and we have discovered that the political determination of prices, wages, and profits leads to chaos when self-interest supersedes the fine fever of patriotism—as it eventually does. I do not mean to imply that we can do without controls over prices, production, and distribution in time of war; but I do suggest that we can learn something from their operation. Even with a united national purpose these controls work badly when human abilities are inadequate for the superhuman task, when personal or departmental jealousies crop up among officials, and when pressure groups try to prey on the rest of the public. Every day more Americans are beginning to understand why our forefathers feared the caprice and tyranny of power.

The impersonal processes of the market in determining prices and wages and in allocating productive resources will, in normal times, save us from the fumbling of bureaucrats and from the Babel of confusion, un-

certainty, and annoyance produced by their regulations. But these market processes will not save us from paying toll to those who monopolize and restrict entry to markets or jobs.

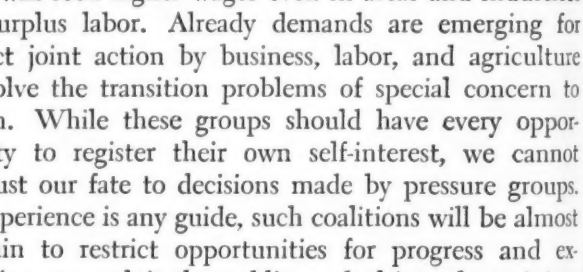
If we want an economy in which we are free to try out new ideas, develop new products, and introduce more efficient methods of production, if we want an economy in which there are great opportunities for men of imagination, inventiveness and energy, if we want an economy wide open to progress, then we must have a free field and fair competition for all comers—without collusion as to prices, markets, or production. This is the only basis on which we have a right to demand freedom from governmental regulation for ourselves and on which we can combat monopolistic tendencies in other quarters.

Let us stand squarely for the principles of the anti-trust laws and against all collusion and combination in restraint of trade. Let us insist that the government review with a critical eye every combination and consolidation which might restrict competition. Let us face frankly the problems of economic power arising out of price leadership and encourage every honest effort to find means to deal with them. Let us not shrink from questions as to whether some great aggregations of plants are too large for efficiency, free entry into the industry, and a free price. While we resist the efforts of the Department of Justice to extend the anti-trust laws by far-fetched and distorted interpretation, and while we fight every attempt to use them as a tool of persecution, let us cooperate in sincere efforts to modernize these laws and extend them by specific legislation to monopolistic practices they cannot now reach. I do not have a simple formula for this, but I believe we must try to find one.

We can then, better face the problem of the growing monopoly in labor which is threatening to make the free enterprise system unworkable. Today labor is going through a stage of empire building reminiscent in some ways of a similar stage in business three-quarters of a century ago. Witness the same buccaneering spirit, the same concentration on selfish interests, and the same disregard for the public welfare. Business leaders learned the hard way that the public will eventually rise up against those who prey upon them. Will our labor leaders be wiser? The right to collective bargaining to protect the weak position of the individual employee is one thing—but the grant of unlimited monopoly privilege to combine into a private government which can dictate its own terms to businesses, industries, communities, and even to the government itself, and which can start a wage-price spiral such as to hinder the war effort and make full prosperity impossible in time of peace is something quite different. We need to find a middle way which will prevent employers from exploiting employees but which does not sow the dragon's teeth. The exercise of arbitrary power by labor threatens not only business, but also all workers outside the unions and all those dependent on pensions and savings for their existence, and ultimately, of course, the well being of union workers themselves.

The idea that the labor problem can be solved if great, powerful organizations of employers will sit down with great, powerful organizations of labor is a delusion. If our experience in the N.R.A. and in the war teaches us anything, it is that the best that can be expected in the long run from such a situation is an armed truce with intermittent civil war. And every truce would be a monopolistic arrangement to take advantage of those not members of the great organized groups. Business and labor unions, whenever confronted with postwar readjustments that are unfavorable to them will be sorely tempted to protect their own special interests at the expense of the public. There will be efforts on the part of businesses, abetted by labor unions, to limit productive capacity, to raise tariffs, to obtain subsidies, and to maintain prices at artificially high levels. The unions will oppose labor saving changes and will seek higher wages even in areas and industries of surplus labor. Already demands are emerging for direct joint action by business, labor, and agriculture to solve the transition problems of special concern to them. While these groups should have every opportunity to register their own self-interest, we cannot entrust our fate to decisions made by pressure groups. If experience is any guide, such coalitions will be almost certain to restrict opportunities for progress and expansion, to exploit the public, and ultimately to injure even the businesses, workers, and farmers included in them. We cannot afford a postwar N.R.A. Resort to temporary government regulation in the transition from war to peace may, however, be necessary in cases of great hardship.

We can be prosperous beyond our dreams—all of us—workers, farmers, and business men—but one of the prerequisites is the self-discipline of accepting competition for ourselves as well as others.



President, McGraw-Hill Publishing Company, Inc.

'44 "Musts" for '54 Markets

As 1943—40th anniversary of Kitty Hawk—draws to a close and we are able to see the top of the plateau in the production curve that lies not far ahead, it is a good time to take steps to by-pass the poorhouse on the other side of the hill.

One obvious way of judging the future is by the past, but if we did that in the case of aviation, the future would be dark. On the other hand, to listen to the pleasant fancies of the "million plane" boys is only visionary hoping. Somewhere in between—and nearer to the lower limits—is the best place to begin our range-finding of the future.

Such a practical beginning will be found in the survey of the postwar aviation market starting on page 114. It represents more than a year of work on the part of the author and considerable collaboration by the editors of AVIATION. It is not the last word, but the first word on the subject, and it will be modified many times as conditions change and new thinking follows accordingly.

Our survey leaves us with an industry that does *not* compete with food or steel, but represents a very respectable volume of business. But surveys only measure business, they do not *create* it. Business is created by demand, and demand must be created by merchandising perspiration.

Surveys do, however, indicate ways and means. Whether the postwar volume is greater or less than our estimate depends directly on the strength of our sales effort. In recent years our salesmen have had too many opportunities to grow soft. In general, our sales effort is in a dangerously weakened condition. Steps can and must be taken to remedy this situation.

Here are some things that can be done to create a brighter future:

Let's realize that the war we are fighting will *not* end wars. It is being fought to preserve a philosophy of life which may be threatened again and again if we don't do something to secure it after victory. With the ever-increasing range of aircraft, our next attack could blast Detroit as easily as Pearl Harbor.

SOON THERE WILL BE more than 5 million people in aircraft manufacturing and in the air services. With their dependents, they represent a considerable voting bloc. This group should know how important it is for us to possess the most powerful and up-to-date air force in the world. It is the duty of each of them to exert every possible influence toward the establishment of that air force, first for the preservation of peace, second for the preservation of the aviation industry as an instrumentality of peace. If reasonable productive capacity is maintained and continuous research and design development encouraged by adequate "seed money" we will have gone a long way toward world security, and would-be world conquerors will think more than twice before attacking.

The wartime contributions of the Civil Air Patrol have proved the value of an aeronautical home guard, and government subsidy of personal flying and flight training must be continued in some form akin to that of the Civilian Pilot Training Program. Only by such an arrangement can it be possible for youth in moderate circumstances to receive flight training at a sufficiently early age. A subsidy to provide large numbers of small landing areas throughout the country would bring benefits in work and sale of materials to many parts of the nation not readily reached by any other means. Even more important than subsidy is sensible government regulation. Education will do more to prevent accidents than stifling legislation.

BUT PERSONAL PLANE BUILDERS should not sit back and wait for the aid of government. First they should apply wartime production short cuts to their manufacturing and pass along the savings to the purchaser. This goes for the producers of parts and accessories as well. The plane makers should build their sales and service organizations now, attracting the best distributors and dealers and locating them in strategic centers. Fixed base operators should lay plans now for greatly increased recreational facilities at their airports, patterning them along the lines of inexpensive boat clubs (see "More Fun at the Airport," page 38, Nov. 1940 AVIATION).

Moreover, plans should also be made now for a nation-wide fly-it-yourself service to utilize surplus planes and provide returning service pilots with an opportunity to do some flying for pleasure and business. Future aircraft shows must be planned to prove that flying is for families and not fanatical daredevils. The Army and Navy Air Forces can furnish all the necessary thrills, incidentally showing the taxpayer what he is getting for his money.

Scheduled and non-scheduled operators must work toward higher efficiency and pass the savings on to the consumer in lower fares. Merchandising will play an important part in the future of air transportation as well as in manufacturing. Development of lower fare second-class services, time-payment vacation travel, and similar ideas, will do much to attract passengers who pay fares out of their own pockets rather than on expense accounts.

These are but a few of the things we must be planning in 1944. We will have much more to say about them in the months to come. We must act now so that aviation—the victor in the war—will not become the vagrant of the peace.

Leslie E. Neville

EDITOR

AVIATION'S
WAR COMMUNIQUE
NO. 24

Swiftly growing carrier force portends powerful blows reaching closer and closer to Jap homeland. Air power arm of carrier forces, too, rapidly gains more strength with addition of Grumman F6F *Hellcats*, such as this one—which features long range droppable gas tank—shown aboard unnamed carrier "somewhere in the Pacific." (Official U. S. Navy-International photo.)

America at War

New 15th Air Force begins pounding Germany from south, opening way for shuttle-run schedules between England and Italy . . . Boeing B-29 nears "final test" . . . More people bet production will top 9,000 by year end.

FROM NOW ON through the winter, Germany will be subjected to new air attacks in the form of: 1. strong missions of the newly-formed 15th Air Force from Africa and Italy, which will take advantage of the fair weather which settles down about the last of November; 2. shuttle runs by both AAF and RAF between Britain and Mediterranean bases, terminating at the end that offers the best landing conditions; 3. attacks by 1,000-plane missions from both British and American forces, subjecting the enemy to potential 2,000-plane blows at the same time; 4. attacks by the Boeing B-29's, which may begin at any time, reaching any points in German-held Europe with still heavier loads of explosives; and maybe, 5. assaults by American and/or British air forces, flying from bases on Russia's Eastern front.

In one recent month, U. S. and British planes based in Britain dropped 20,000 tons of bombs on Axis Europe. Bombers and their escorts destroyed or damaged 1,387 German planes. U. S. 8th Air Force B-17's and B-24's accounted for nearly all of them—1,261—since they operate in the daytime. The heavies and the mediums unloaded 5,533 tons of the bombs. But the Royal Air Force, mostly engaged in area bombing a

Captured Italian air bases—such as this one already used by omnipresent P-40's and C-47's—pave way for bombing of Germany from south as well as from English bases. Good southern weather will not only make possible shuttle runs, but will also give additional alternate landing places for bombers operating from run's northern end during inclement weather. (International News photo.)

night, put down the major portion of the total—14,060 tons.

One of the first things Lt. Gen. Carl A. Spaatz did when he was appointed commander in chief of the American air forces in the Mediterranean was to send a heavy mission of bombers over the Messerschmitt plant at Neustadt in South Vienna. This first attack by the 15th resulted in "severe damage" to the enemy. Our losses were not disclosed. Before that, the RAF had given Leipzig its first large-scale bombing of the war. This was a notable achievement, because the city, Germany's third important industrial center, is over 500 mi. from English bases—a long distance for British night bombers.

The 8th Air Force's greatest invasion of Germany at this writing was its attack on the vital ball and roller bearing plants at Schweinfurt. The loss was 60 planes and 593 crewmen, but it would have taken many times that loss of material and men to hit the Reich such a heavy blow any other way. Indeed at this time it could not be done any other way. Nevertheless, both Gen. H. H. Arnold, AAF chief, and the President felt that the public should know why the mission was sent against such odds, and they explained it in press conferences.

The AAF based in England has lost, during the past six mo., about 6,000 crewmen and nearly 600 heavy bombers, not counting escort fighters. Secretary of War Henry L. Stimson says that losses of the British and American forces operating against Europe average less than 5 percent of total planes engaged. This is a low figure—especially low for belligerents whose aircraft production is already large and increasing every month.

The percentage of German losses is not known, but it must be greater than the Reich can afford. In one AAF *Fortress* attack, on Muenster, an important German rail center, 102 Nazi fighters were brought down. Bomber gunners got 81 of them and the accompanying Republic P-47 *Thunderbolts* took the rest. This was part of a three-day rampage by the *Fortresses* in which

(*Turn to page* 339)

Let's Be Practical About Postwar Plane Markets

By **E. E. LOTHROP**, *Market Analyst, Sperry Gyroscope Co.*
as told to
JOHN FOSTER, JR., *Associate Editor, "Aviation"*

Realistic analyses of aircraft requirements show sharp disagreements with visionary prophets whose crystal balls show plane-filled skies.

THE FLOOD OF FORECASTS visualizing tens or hundreds of thousands of aircraft cramming the postwar "wild blue yonder" represents a definite threat rather than a help to the aviation industry.

Such prophesies—many made by people not even in the business—give a falsely optimistic picture of the industry's employment and profit-making potentialities, and this kind of preview simply doesn't stand up when viewed with a coldly analytical eye to facts.

More than a year's concentrated study, including constant checks and rechecks with manufacturers, airlines, independent fact-finding groups and government officials, leads to the inevitable conclusion that, while the aviation industry will be considerably larger than it was before the war, its markets will not be great enough to keep it anywhere near its present position as the world's No. 1 industry.

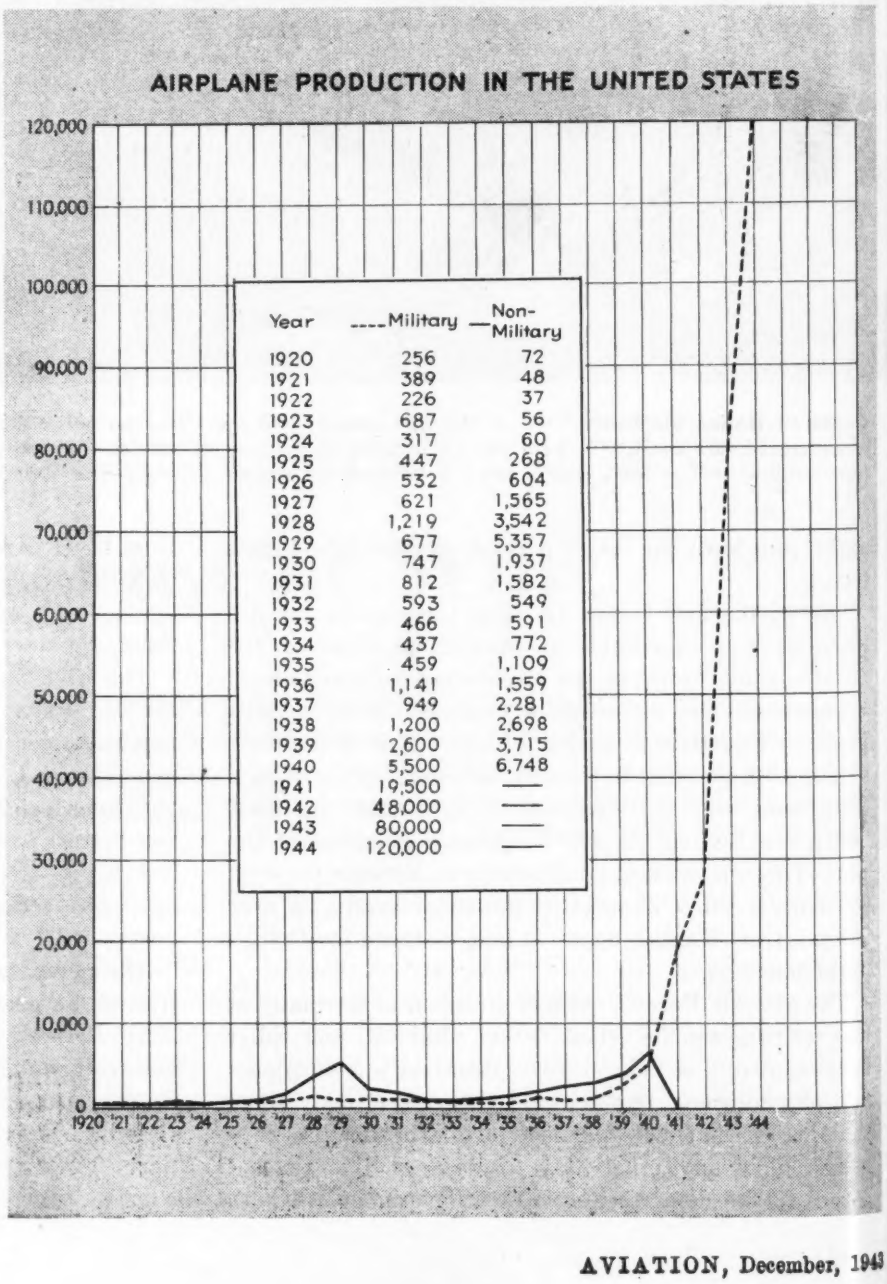
This present study appraises two markets: The first identified as V-2, covering a period of two years after the cessation of hostilities (including those with Japan) and embodying the climax of the transition period; and second, the V-5 market, covering the five years after final victory. The V-5 market will thus overlap the V-2 period.

Analysis of the study shows that the V-2 market will require just about 37,700 aircraft of all types, or less than four months' production at today's rates. By far the greatest majority of these craft may be expected to be military planes, for it is a near-unanimous opinion that the United Nations will have to maintain some sort of international police force. Military authorities generally agree that the United States' share of this force will approximate 20,500 planes which, with spares, will have a total value of $2,785,400,000.

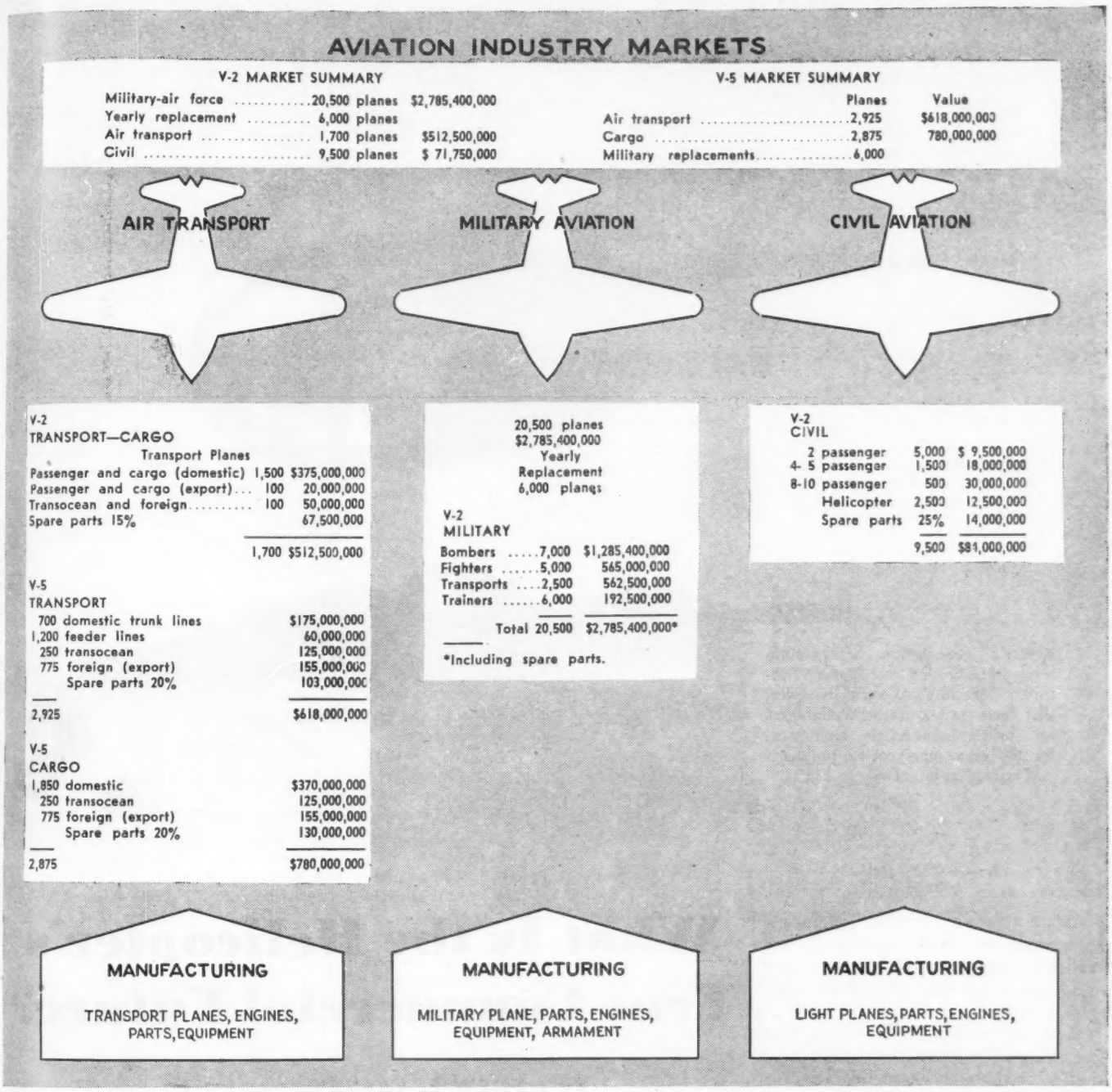
Such a force, measured according to current and projected strategy, would include a minimum of 7,000 heavy, medium, and scout bombers with a total value of $1,285,400,000. Next highest, from the dollar value standpoint, would be 5,000 long-range fighters with estimated value of $565,000,000. And half that number of transports—2,500—would represent a value of $562,500,000. While a higher percentage of transports are required today, military men believe that about 10 percent of the total number of planes would prove adequate to maintain a police force-type operation. Training plane requirements are estimated at 6,000 units, with valuation of $192,500,000, figures arrived at being on the basis of both peace and wartime experience.

Obviously, we will have a great many more than 20,500 planes available from all military sources when hostilities cease, the day the police force must be ready. Thus, the 20,500 total will not have to be built, so that this figure becomes the absolute maximum for the V-2 military market. Replacements, based on normal peacetime attrition rates, are calculated at 6,000 planes per year for the entire force.

The ultimate military market will de-



Year	Military	Non-Military
1920	256	72
1921	389	48
1922	226	37
1923	687	56
1924	317	60
1925	447	268
1926	532	604
1927	621	1,565
1928	1,219	3,542
1929	677	5,357
1930	747	1,937
1931	812	1,582
1932	593	549
1933	466	591
1934	437	772
1935	459	1,109
1936	1,141	1,559
1937	949	2,281
1938	1,200	2,698
1939	2,600	3,715
1940	5,500	6,748
1941	19,500	—
1942	48,000	—
1943	80,000	—
1944	120,000	—



pend on five principal factors: First, length and severity of the war and, as a related factor, the number of planes surviving hostilities; second, decisiveness of the victory and the terms of the peace to follow; third, the role of the United States in international policing; fourth, new developments in military craft and the resulting obsolescence rate for existing craft; and fifth, public and congressional reaction toward continued military spending.

Even though there be a reaction against this spending, it is obvious that we will need thousands of planes in our American air forces for self protection, for training new pilots and, just as important, for research. The fallacy of building but a few hundred planes each peacetime year for military purposes has been demonstrated, but the final makeup and size of our standing air force must await the peace and the ensuing public and Congressional reaction to spending.

Due to the fact that the U. S. will have a great many more than 20,500 military planes available, the belief exists in some quarters that a large por-

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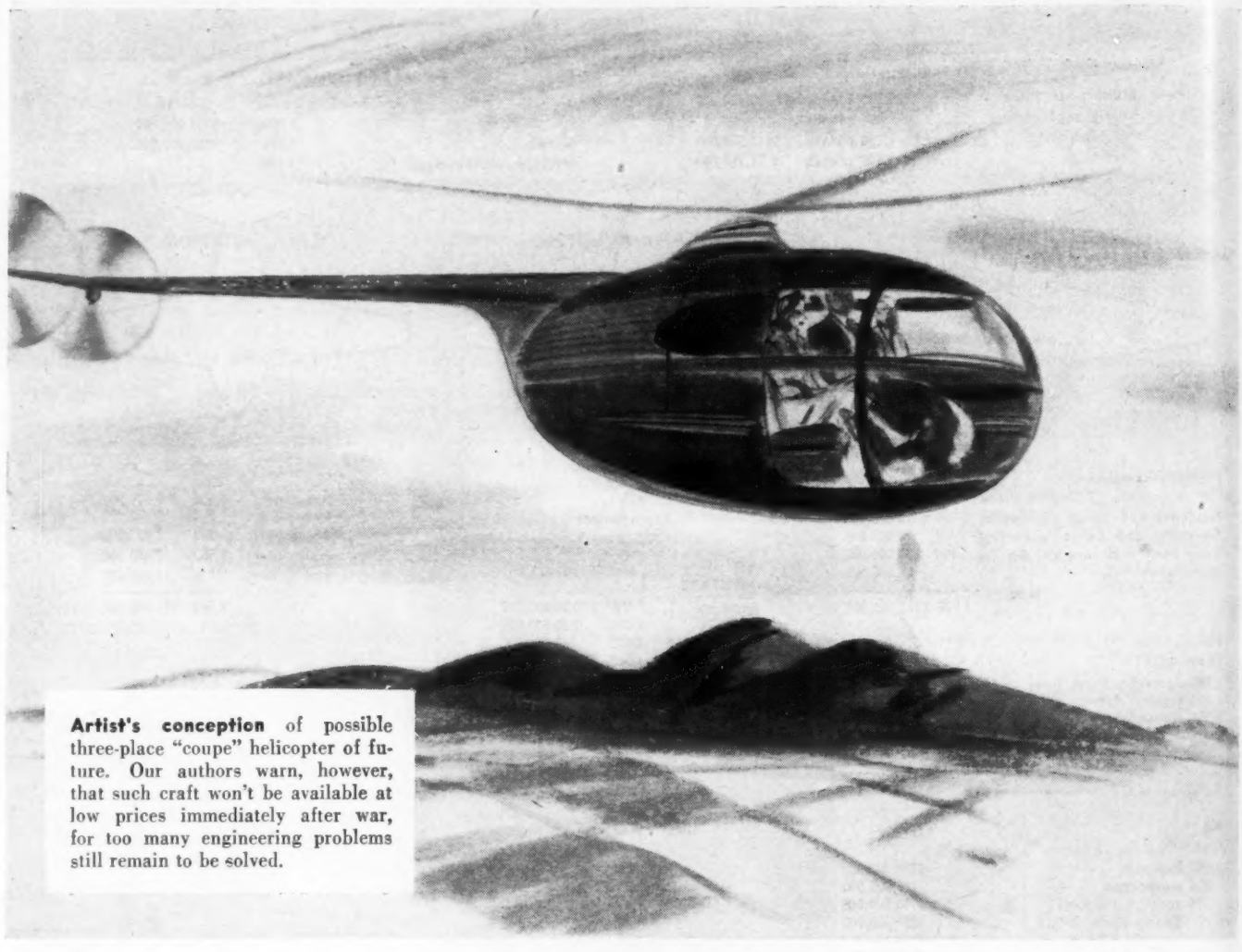
• It would be a pleasant pastime for the aviation industry to bask in the glow of its glorious achievements. Its record of accomplishments during the past three years would certainly justify some resting upon laurels.

But unfortunately we cannot stop for rest. We must look ahead toward the next phase in our development. We must face the cold reality that we will not continue to be the world's largest industry. And with the cooperation of government, we must plan an orderly withdrawal to our proper place in the industrial hierarchy.

First step is to make a realistic quantitative analysis of the probable postwar aircraft markets, and the accompanying article, based on many months of work and study, embodies such an appraisal. Of course, the authors recognize clearly that certain assumptions must be made to provide a base for deductions and that the postwar formula still contains many unknown factors, chief among which is the nature of national and international air policy.

But somewhere a start had to be made —and here it is. Meanwhile, the pages of AVIATION are open for constructive criticism and discussion of this highly important subject.



Artist's conception of possible three-place "coupe" helicopter of future. Our authors warn, however, that such craft won't be available at low prices immediately after war, for too many engineering problems still remain to be solved.

What Is the Helicopter's True Commercial Future?

By **AGNEW E. LARSEN,** *President, and*
JOSEPH S. PECKER, *Chairman of the Board, RotaWings, Inc.*

How this promising craft is engineered—not how it is ballyhooed—will determine the real answer to this big question. There are still many problems ahead. And overselling may undermine the road to their solution unless there is concerted action by the industry.

THE AMERICAN PUBLIC, engineers, aeronautical and otherwise, and practically every type of manufacturer are notably conscious today of the helicopter.

This is so in spite of the fact that there have been but few helicopters manufactured, and these mainly for military purposes. No matter, helicopters are discussed on the radio, in Sunday supplements, magazines, newspaper notices, and in advertisements with a familiarity suggesting that these flying machines are an accomplished product of American industry.

Certainly, this is a very interesting phenomena which bears further examination. It appears that the recent successes of a military helicopter have electrified the public. They have apparently crystalized the dream of the average individual of a safe type of flying machine that could be used for both business and pleasure. This is, furthermore, a confirmation of the opinion held by many engineers and manufacturers that the "rotamobile of the air" is a flying machine that would prove a "natural" for postwar investment and development.

Such widespread interest in the commercial aspects of the helicopter in the coming peace, simultaneous with its introduction as a military machine, points to the birth of a new billion dollar industry.

To those of us who have pioneered in the rotating wing industry, it is evident that we have reached an important turning point in the evolution of this art. Therefore it is imperative to review all of the facts that may contribute or retard this budding new industry.

Development of rotating wing aircraft had been somewhat spotty during the first 15 yr. of the fixed wing airplane's remarkable growth. But in 1923 a new and most fertile mind became applied to the many intricate problems. Our reference is to Juan de la Cierva, whose autogyro development literally cracked the "hard shell of the nut" and revealed an entirely new approach to this age-old problem. With persistent experimentation and tenacious applica-

tion to each of the manifold problems, he produced in rapid order the many stages of the autogyro's phenomenal development—

1. The first successful single-rotor flying machine.
2. The first quantity manufacture of rotary wing aircraft.
3. The first direct control.
4. The first roadable "gyro".
5. The first "jump"-take-off autogyro.

To Harold Pitcairn, the Kelletts, and those associated with them goes the credit of having applied American ingenuity in perfecting the many elements that were finally crystalized into the last word in rotary wing aircraft, namely, the roadable "jump"-take-off autogyro.

Thus, with the solution of the fundamentals, the advance of the helicopter lay bare and ready. With the newly encouraged upsurge all over the world —featuring developments by D'ascania in Italy, Asboth in England, Breguet in France, Florine in Belgium, and Focke in Germany—the time was ripe for the world to have what it had long awaited.

To Igor Sikorsky here in America goes the credit for having seen clearly, chosen wisely, and assembled correctly the many elements which went into rendering to the American public an example of this "personalized flying machine".

Since the inception of Sikorsky's helicopter, the attendent publicity in newsreels and newspapers has been in a great measure overselling. The "imagineering" of the public is now far in advance of the practical development made by the engineers associated with rotary wing progress. But it must be stated bluntly that there will *not* be available to the public a flood of helicopters at $1,500 each the moment peace is declared. The helicopter of today does not possess the elements that would make it possible for an untrained person to fly. All helicopters developed today of any practical note are for military purposes. Others in the proc-

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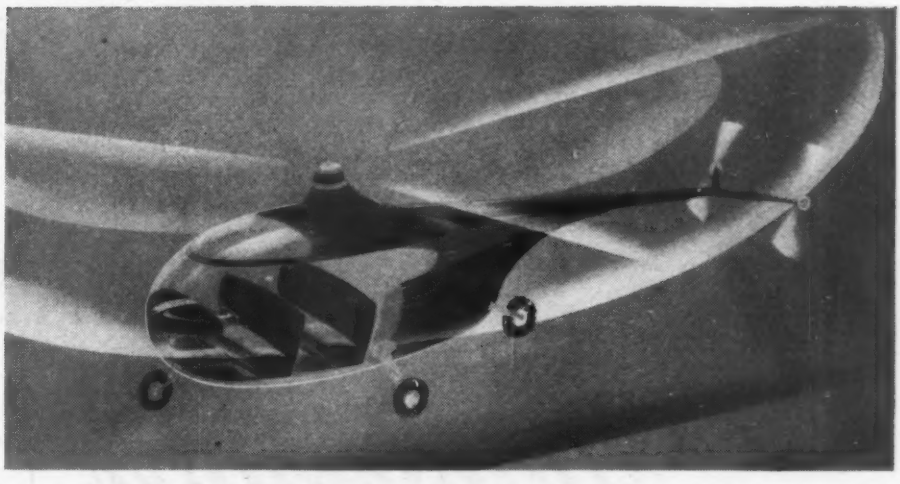
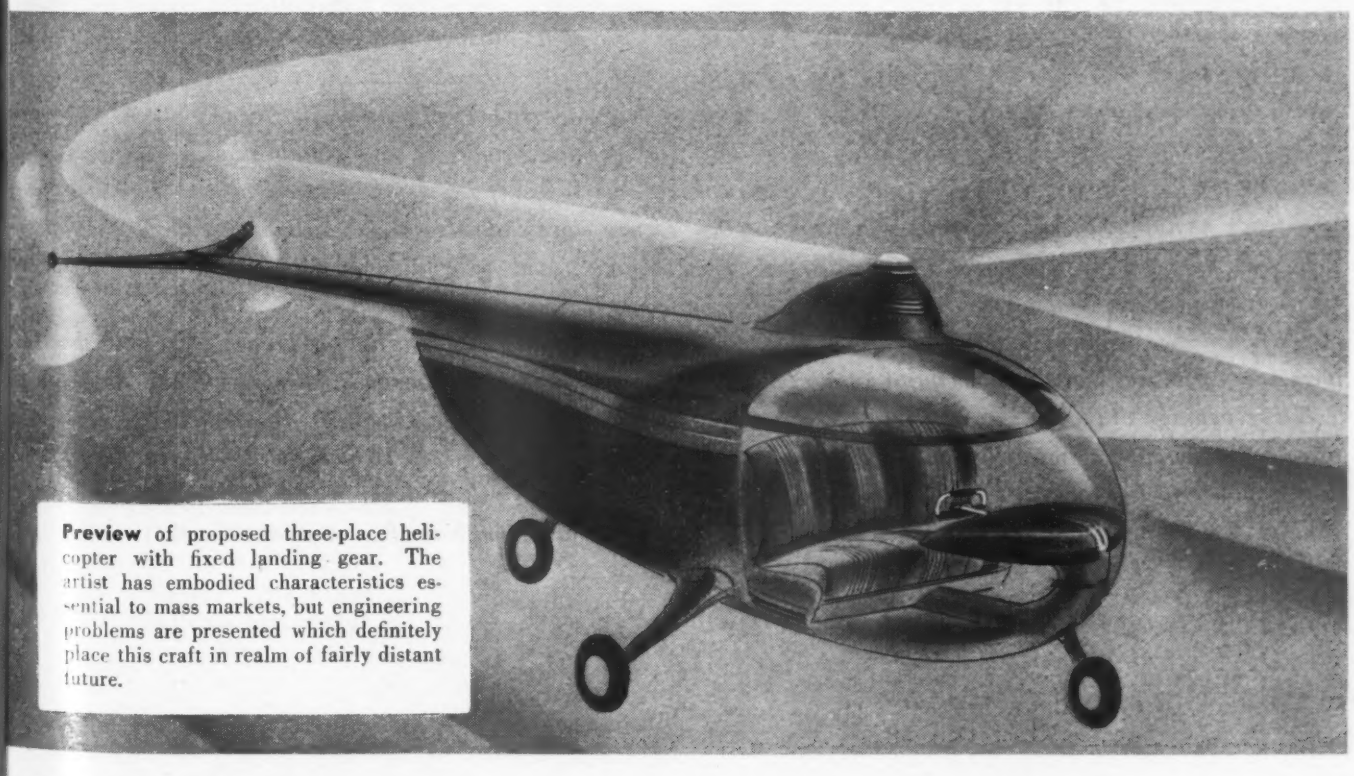


Conception of multi-place helicopter embodying controls of vastly greater simplicity than are available at present stage of rotary wing development. Note twin anti-torque rotors.

• In these days of premature enthusiasm about the helicopter, it is fitting that we present the realistic views of two pioneers in rotary wing aircraft development in America.

Both authors were associated with Harold Pitcairn during his early work in the development of the designs of the late Juan de la Cierva, hence they have vivid recollections of the unfortunate consequences when the public accepted the autogyro before it was technically adanced to the point where it was ready for the public. Their desire to avoid a similar mistake in the development of the helicopter is in full accord with the thinking of the editors of AVIATION.

Since that time the authors have been prominently identified with rotary wing aircraft design and construction. Their new organization, RotaWings, Inc., is dedicated to the solution of the many problems associated with the design and manufacture of all types of these aircraft.



Preview of proposed three-place helicopter with fixed landing gear. The artist has embodied characteristics essential to mass markets, but engineering problems are presented which definitely place this craft in realm of fairly distant future.

AVIATION'S

Maintenance Award For 1943

★

For nearly a decade AVIATION *has made an annual award to one or two airlines in recognition of outstanding maintenance performance.*

Purpose of this Award is to encourage more efficient maintenance procedures and to give due recognition to the men on whom so much of air transport's record and progress depends.

It is impossible to find greater esprit de corps and pride of workmanship than that contained in airline maintenance. But there is never too much incentive for these men, hence they have heartily welcomed the spirit in which the Award has been given.

Now, the incentive of winning the greatest test of this country's history — and the world's, for that matter — transcends anything we may propose. War calls for the most that men can give. To win *a war calls for even more. It is precisely that which is being given by our maintenance men, and if anything else can be asked of them, it must be asked only in the name of speedier victory.*

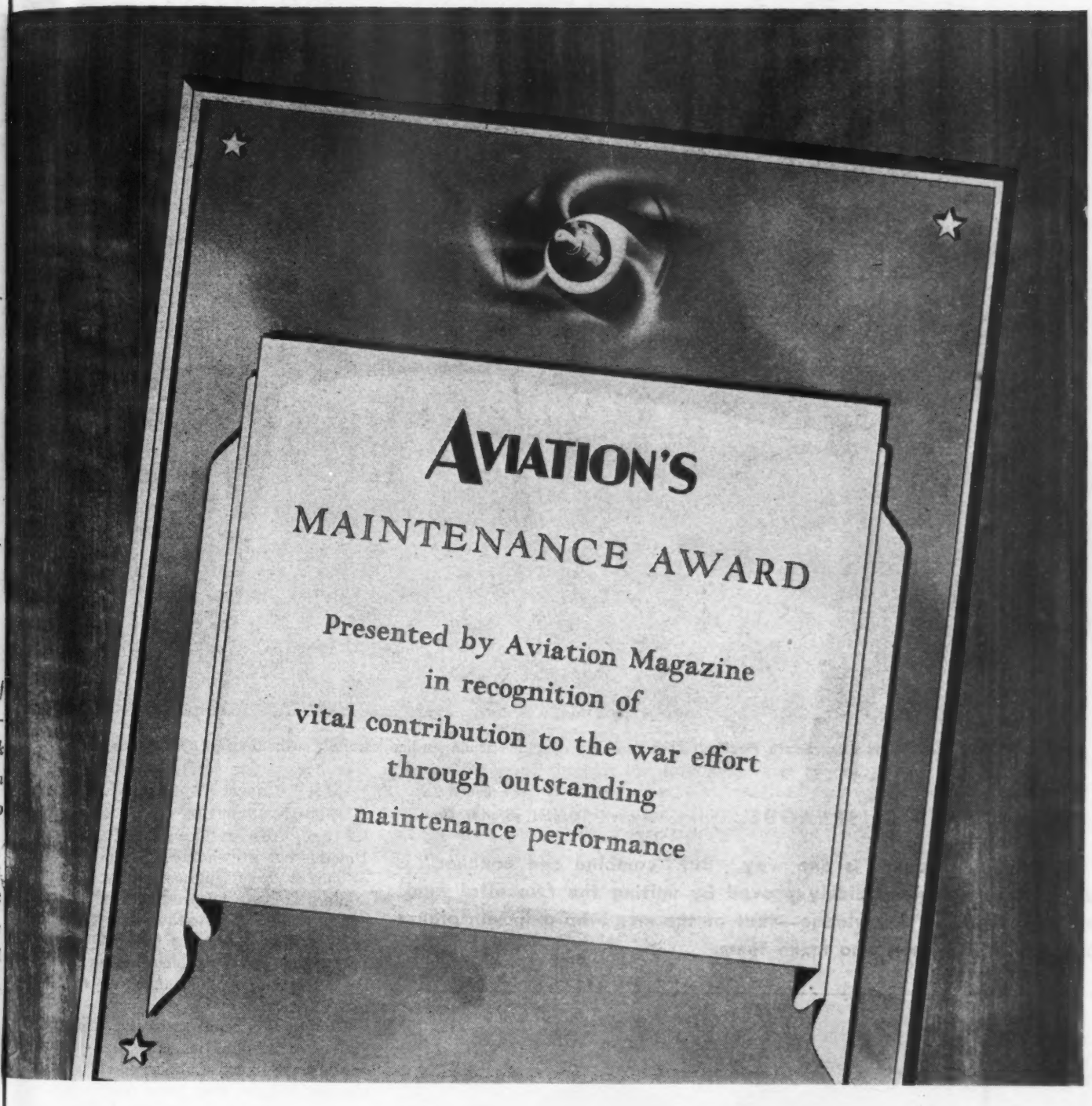
But recognition of the maintenance achievement is ours to give. Let there be full meaning attached to this citation.

The ability to transport is the ability to fight. We are winning this bitterest of struggles by the simple expedient of "gittin' thar fustest with the mostest". The very crux of transport operations — whether it be by air, land or sea — is maintenance. In an important sense, therefore, the work of the maintenance men can mean the difference between victory and defeat, and the magnitude of their effort is to be measured by our present opportunity for victory.

But aviation is our specific field, and all must know our pride in the achievements of its operations. We point to aviation maintenance as the foundation stone of the war effort, because it is needed for war, and of peaceful enterprise because it will have the most profound influence on our lives as we shall live them.

In the instance of total mobilization of resources for a common purpose, the air services of the Army and Navy are closely allied with the airlines. All three are "operations", and recognition of maintenance achievement encompasses them as sum total.

There is no one airline or branch of service that has not shared in this magnificent contribution. AVIATION *is therefore presenting its 1943 Award to the maintenance organizations of all airlines in the United States and Canada, as well as to the service commands of the Army Air Forces and Navy Bureau of Aeronautics.*



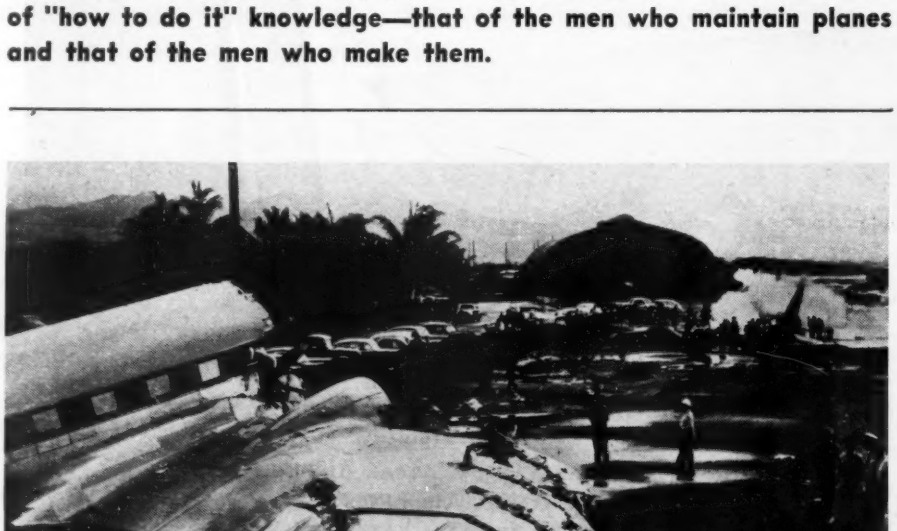
ALASKA STAR AIRLINES
ALL AMERICAN AVIATION
AMERICAN AIRLINES
AMERICAN EXPORT AIRLINES
BRANIFF AIRWAYS
CANADIAN PACIFIC AIR LINES
CHICAGO AND SOUTHERN AIR LINES
COLONIAL AIRLINES
CONTINENTAL AIR LINES
DELTA AIR LINES
EASTERN AIR LINES
INLAND AIR LINES
MID-CONTINENT AIRLINES
NATIONAL AIRLINES
NORTHEAST AIRLINES
NORTHWEST AIRLINES
PAN AMERICAN AIRWAYS
PENNSYLVANIA-CENTRAL AIRLINES
TRANS-CANADA AIR LINES
TRANSCONTINENTAL AND WESTERN AIR
UNITED AIR LINES
WESTERN AIR LINES
U.S. ARMY AIR FORCES
U.S. NAVY BUREAU OF AERONAUTICS

Manufacturing and Maintenance Join Hands

Army transports over South Pacific. They can only operate efficiently when carefully maintained. (AAF photo.)

By **DONALD S. SPRAGUE,** *Service Manager, Douglas Aircraft Co.*

"Divide and conquer" is one way. But "combine and conquer" is another, as Douglas quickly proved by uniting the two vital funds of "how to do it" knowledge—that of the men who maintain planes and that of the men who make them.



Service manuals give complete data on repair work such as this job requires.

SINCE ITS INCEPTION over seven years ago, the service department at Douglas has grown from a small group of half a dozen engineering and maintenance men to the present staff of well over a hundred. And the job has grown, too. It's now the big task of coordinating the service problems arising from the operation of thousands of Douglas airplanes.

During this comparatively brief period of expansion, the scope and organization have likewise undergone a radical change, but the aims have remained the same—to furnish the technical data, information, and material assistance without which continued operation and maintenance of the airplanes would in many cases prove difficult.

For a true understanding of these changes, one must keep in mind the basic functions of a service department. These include preparing and furnishing technical data to military and commercial operators; issuing instructions for, and supervising the salvage and repair of the damaged aircraft; analyzing reports from operators on failures and malfunctioning of parts of the airplane; initiating suitable corrective action to eliminate such troubles; supervising modifications on delivered airplanes; consulting engineers with regard to problems which arise during operation

of airplanes; assisting in the solution of these problems through redesign on future models; and, finally, providing through field service representatives assistance to both military and commercial operators in this country and abroad.

In the early days when the number of airplanes in service was relatively small, a maintenance or operations problem was referred back to the small group which then comprised the service department, and the matter was handled on an individual basis. However, the number of airplanes increased. Moreover, various problems and difficulties began to recur. So the necessity for coordination and standardization became apparent.

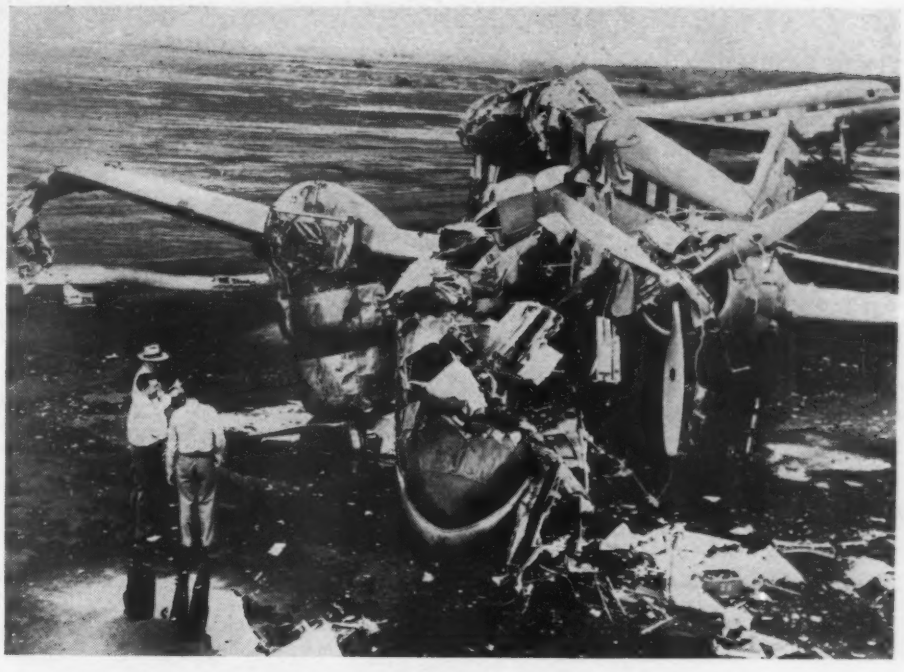
The calls for technical data (these had formerly been worked out on an individual basis) attained a frequency necessitating standardized manuals to which operators could refer when making a change or from which they could obtain technical data without getting in touch with the manufacturer's service department. It was for this reason that the now familiar *DC-3 and DST Typical Repair Manual* was prepared by service department personnel in conjunction with engineering. This manual represents a synthesis of requests received from operators for drawings, stress analyses, and typical repairs encountered in operation of the planes.

As an example of the steps, such as given in this manual, leading to the preparation of drawings and stress analyses for an outer wing handhole, it was first necessary to study the requests received from operators for the location of inspection handholes along the outer wing. Then load factors and allowable stresses throughout the affected area were determined by consulting with the stress group in engineering, after which drawings were made showing the location and dimensions of the requested handhole.

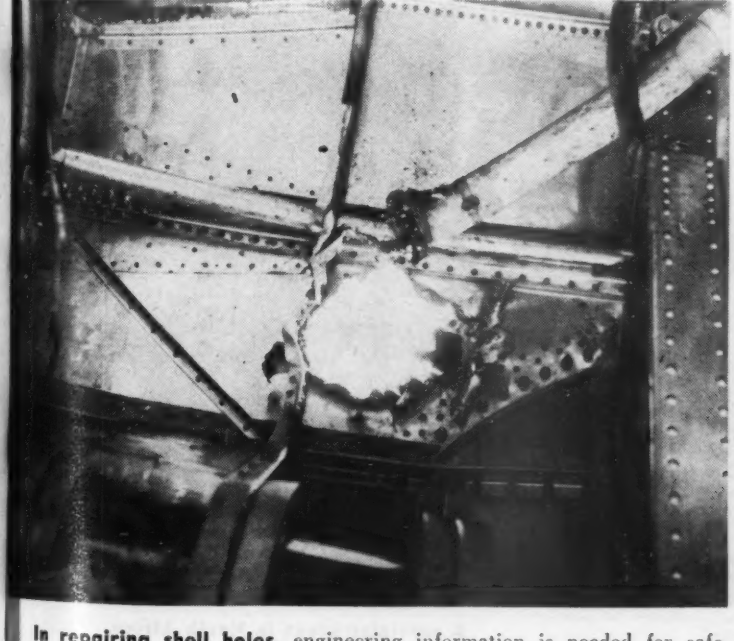
Modifications and repairs described in the manual are the result of many service contacts with operators, and the time consequently saved through publication of a reference work of this type has been to the advantage of all concerned.

In addition to the *DC-3 and DST Typical Repair Manual,* we have assisted in the compilation of data for repair manuals on our cargo and combat type airplanes. Furnished with each airplane, these describe in detail the methods and materials to be used in repairing damage incurred in combat areas or at bases far removed from the facilities offered by large repair depots. These manuals differ from the *Typical Repair Manual* in that they are prepared to be used in the field rather than by airline engineering groups. For this reason, repair procedures and methods are explained at great length with the idea of furnishing required information, drawings, and photographs so that even relatively inexperienced mechanics can effect the needed repairs without engineering assistance.

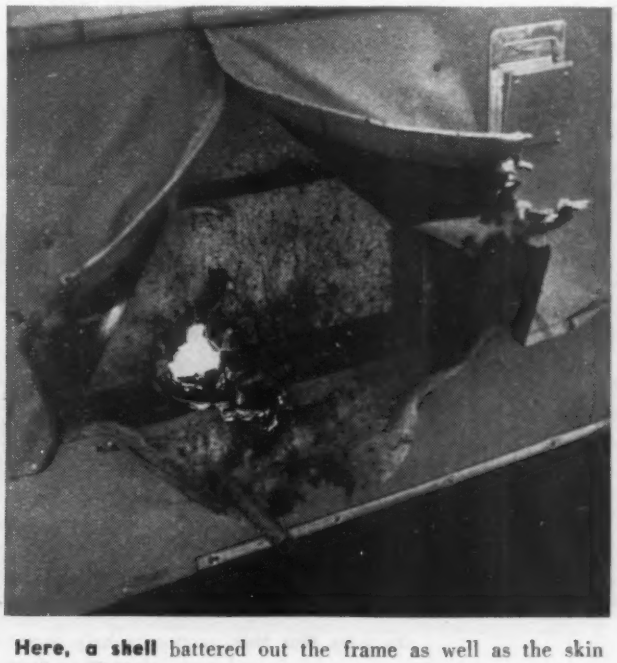
That these manuals have proven of real help to operating organizations is evinced by the numerous reports of on-



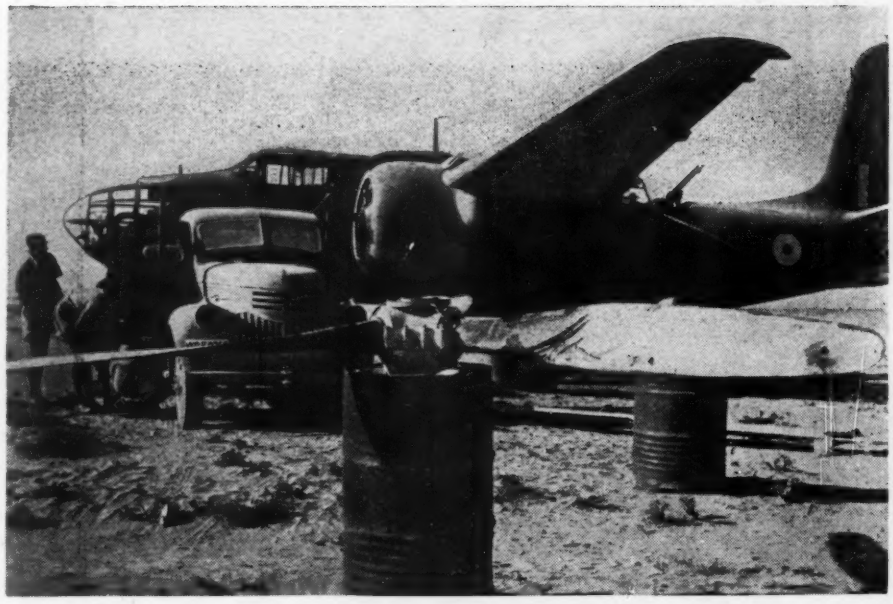
A Douglas service crew rebuilt this airliner thousands of miles from the factory.



In repairing shell holes, engineering information is needed for safe proportioning of work.



Here, a shell battered out the frame as well as the skin and insulation.



One aileron gone, prop blade shot up. Yes, plenty of work for the repair crew of this *Boston* bomber.

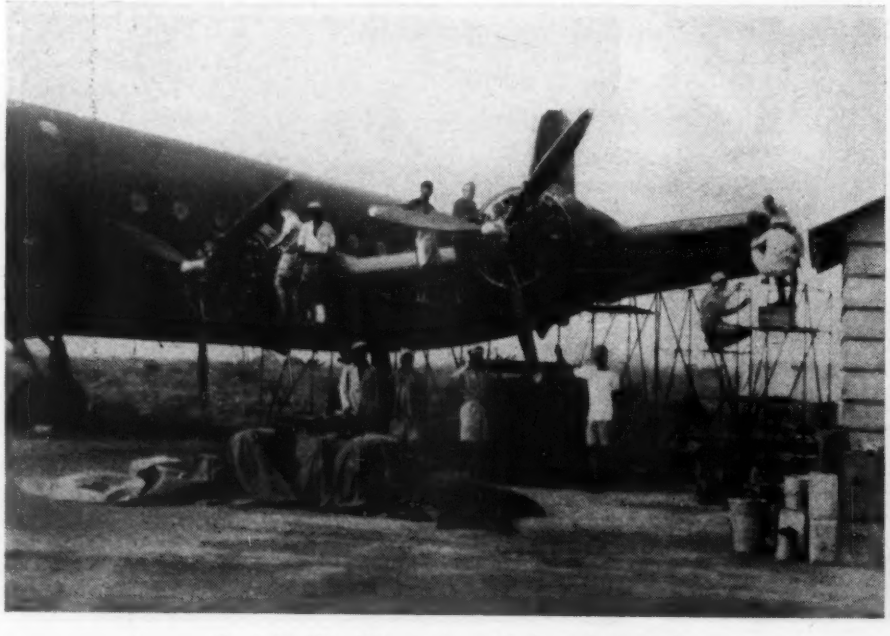
the-scene repairs made with the assistance of the contained data. One such report told of an instance in which an RAF pilot, making an emergency landing in a sandstorm at a field "somewhere in Africa," folded up the nose gear on his DB-7 light bomber when he skidded off the runway. Damage was found to be not too severe, and it was therefore decided to make a temporary repair so that the plane could be flown to a major depot. A study of the drawings of the nose wheel tunnel structure contained in the specific DB-7 repair manual provided sufficient information to start the repair, and with the help of some angle iron, bolts, hand tools, and ingenuity, the nose wheel was soon locked in the down position and reinforced sufficiently to allow the airplane to be flown safely away.

For a service department to be of maximum assistance to its operators at the present time, the dissemination of such technical data is of prime importance. This is why we have supplemented our repair and operational manuals by publication of a monthly magazine, *Douglas Service,* through which we hope to reach the large number of maintenance personnel, both military and commercial, who ordinarily would not have access to the so-called technical publications but who are nevertheless actively engaged in maintaining and operating our airplanes at bases in all parts of the world.

Through this magazine, we intend to convey the latest service changes, maintenance hints and procedures, and other data not ordinarily found in the technical orders but which are vital to the proper servicing and operation of our planes. Due to unforeseen conditions encountered through actual operation, procedures as outlined in a maintenance manual or technical order may have to be drastically altered almost "over night," and to keep field personnel informed as to these changes, we feel that a periodic publication of this nature is requisite.

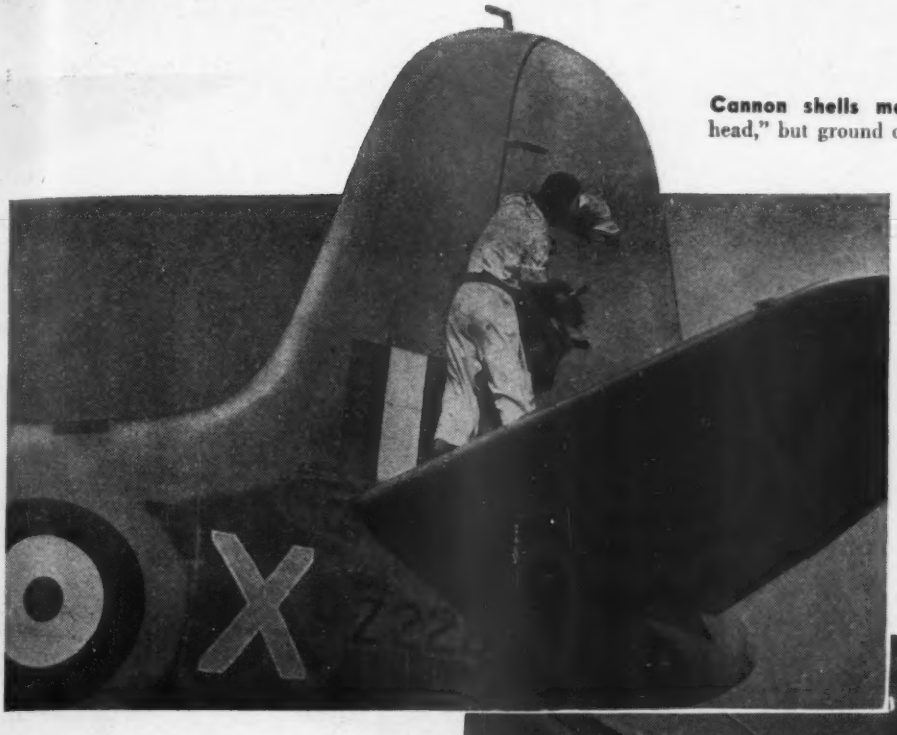
Naturally, since other plants are manufacturing our equipment, close coordination between the various service branches is required, hence *Douglas Service* contains a summary of the latest items reported by these branches on the particular type airplane manufactured by each. In this way, it is felt that no matter what type of airplane is being maintained at any base, there will always be a section of the magazine devoted to that particular model. Such a publication is symptomatic of the widespread growth of service activities, and it points up the consequent necessity for some means of prompt and accurate dissemination of technical data to new operators and maintenance personnel.

Whereas in the early days of the service department we had a small group which handled any matters pertaining to maintenance and operation, it has been found expedient as the organization has expanded to assign specialists to investigate the problems involving particular components. Thus, we have a small group of highly trained men with engineering backgrounds who specialize on problems involving repair and salvage. Others are engaged in the elimination of service troubles occurring in the systems



On jobs like this, engineers help maintenance men—and gain a lot of information themselves.

A servicing scene in North Africa. These men pass on their "know how" to others.



Cannon shells make "holes as big as your head," but ground crews patch them in a hurry.

of the airplane, such as hydraulic, electrical, armament, and power plant. Because these men are specialists, problems are referred directly to them for corrective action, thus eliminating much lost motion. These men are in position to analyze the source of trouble quickly, and accordingly either to instigate design changes or to approach directly operators in the field with suggestions for improved maintenance.

Importance of such specialists in influencing future design can hardly be over-emphasized. A man who is thoroughly familiar with the operating experience gained on a system over a period of time can furnish the engineering staff with much information of decided assistance in redesigning to eliminate recurrent service difficulties and excess maintenance on future models.

It is definitely felt that through the increased specialization by members of a service department, the service and assistance given the various operators can be materially increased.

Coincident with the growth and specialization of office personnel has been the increase of the field service staff, which is providing an invaluable source of on-the-scene instruction and assistance to both military and commercial operators. Formerly, when an operator

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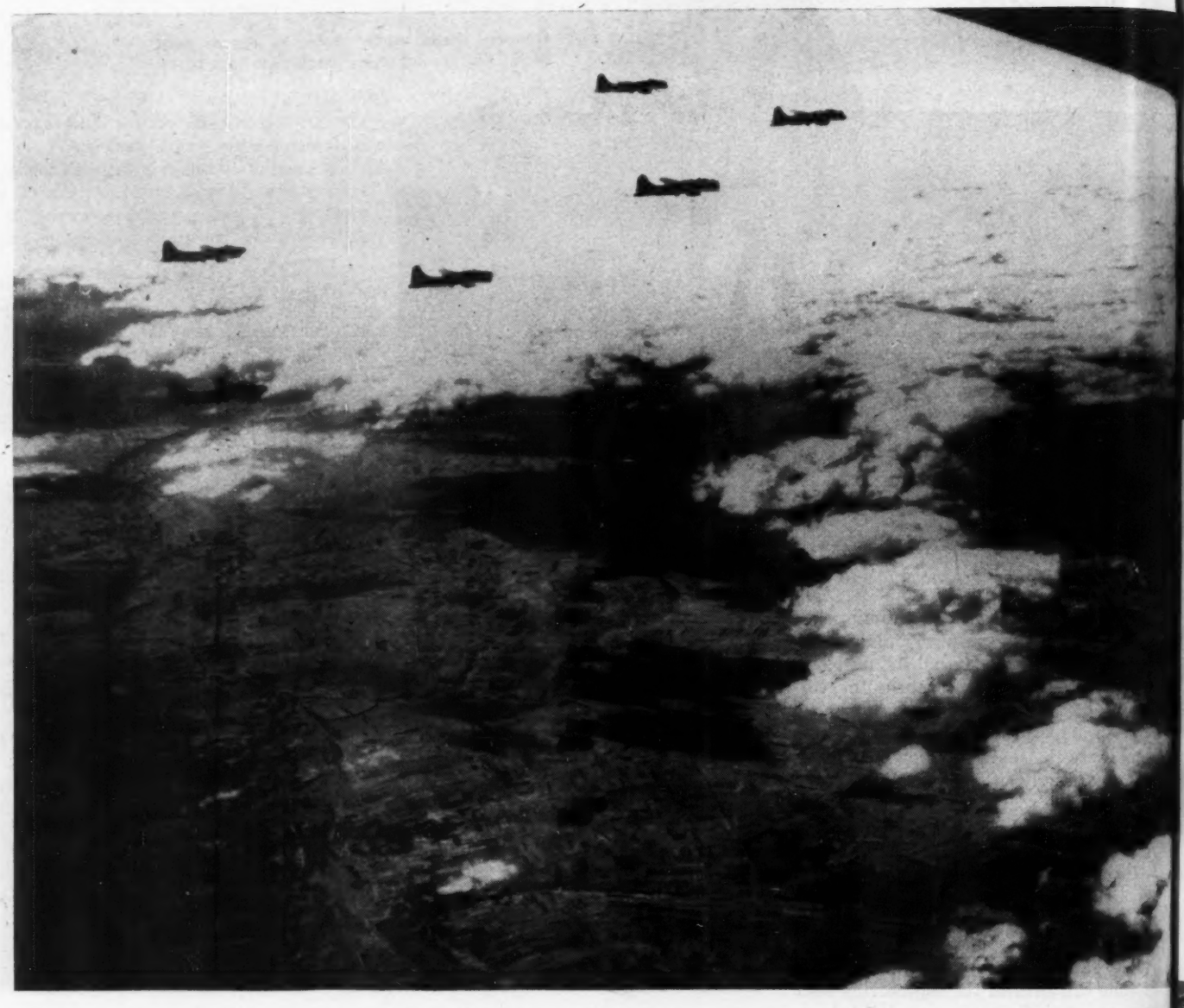
Both shells and bullets were stopped by this airliner at Pearl Harbor. Another tricky repair job.

'Chutists clear ground for airborne troops. Later, maintenance men will have plenty of shot-up planes to repair. (USASC photo.)



Action shot of Amiens-Glissy raid in which B-17 "Tough S——" received near-fatal wounds described by Author Cave. It was just a few moments after this "bombs away" snap was taken that Focke-Wulf 190 collided with *Fortress*. (International photo.)

"Sighted Wreck, Repaired Same"

By MYLES V. CAVE, *"Aviation's" British Correspondent*

How mobile service units of 8th Air Force Service Command roam England fixing damaged aircraft which "didn't quite make it."

CONTINUATION by the 8th Air Force of its day bombing activities has vindicated Gen. Ira C. Eaker's theory—i.e., through greater bombing accuracy a smaller gross bomb tonnage can effect damage equal to that of a night "saturation" raid. At the same time, bombing by day supplements the vicious RAF onslaughts and puts the air offensive on a 24-hr. basis.

But day bombing inevitably means a heavy toll of shot-up aircraft which soon become a growing liability if repairs are unable to keep step. In fact, speed of repair is a critical factor in maintaining the pace needed to crush the Nazis surely and quickly.

The mobile service unit, pioneered and developed in the European theater by Maj. Gen. Henry J. F. Miller, commanding the 8th Air Force Service Command, is providing the answer to this important requirement. It is simply a highly developed process of taking the repair shop to the wrecked plane—instead of the former time-and-trouble method of taking the plane to the repair depot.

Partly responsible for the recent buildup of AAF bomber strength in the European theater, this mobile service has been so successful that the number of units is being multiplied many times over to meet increasing requirements. In fact, the units are now organized under a sub-command known as Advance Air Service, with Col. Charles M. Steinmetz serving as commander at headquarters. Assignment of the repair

A *Flying Fortress,* badly damaged after raising hell over Naziland, makes emergency landing in English field. Mobile service units arrive to completely repair plane for return to base under its own power. This method puts ship back in service much quicker than former system of dismantling and hauling it back to an established depot for repairs.

units to various jobs is handled by a central control board which makes a preliminary investigation of the damaged planes. If it is decided that the ship is repairable, then a mobile service unit moves in; otherwise all usable material and parts are salvaged.

Control headquarters maintains direct liaison with operational commands and with an advance air depot in the immediate vicinity of each combat wing. All advance depots provide complete maintenance, repair, and service facilities for the type of plane in service in their respective wings. Mobile units are allocated to all advance depots and, in addition, there are "floater" units attached to headquarters to cover remote

One of eight huge trucks of a mobile service unit which now travels over Britain repairing damaged bombers and fighters. If plane is so badly wrecked that mobile units can't put it into flying condition, it's ready for salvage or junk heap.

Mobile service units are completely equipped for anything. Working in this shop-on-wheels are, left to right, Staff Sgt. G. L. Wintersole of Portsmouth, Ohio; John Bakalian of Paterson, N. J., a Lockheed Overseas Corp. technician; and Sgt. Reimers of Wellows, Calif. A repair crew of a mobile unit consists of around 19 men.

All tools and equipment are packed compactly. Each mobile unit of Eighth Air Force Service Command carries a nearly complete line of accessories and spare parts.

regions when the need arises. When there are no specific jobs for these travelling units, they are kept at airfields repairing damaged planes. Being mobile, they quickly can be diverted from one squadron to another to meet urgent demands for extra service.

A typical example of how the mobile service unit swings into action is contained in the story of a *Flying Fortress*, named "Tough S——," which played a star role during a mission to Amiens-Glissy, a very heavily defended French target.

Flying in their customary tight formation, the *Fortresses* had just unloaded on their objective and were wheeling around at better than 200 mph., observing results, when Tough S——, one of the outside planes, fired at an FW-190 which was making a climbing turn. The shooting of one of our gunners—2nd Lt. Robert C. Black—was deadly, probably killing the German pilot. This caused the 190 to continue in its turn, and it whammed into the starboard wing of the Tough S——, leaving one of its 20 mm. cannon burled deep in the Yankee's wing.

The Focke-Wulf then skidded over the top of the wing surface, putting out the No. 3 engine, bending up the waist gun position like a pretzel, and finally gouging a big hole in the stabilizer fin.

It is safe to reckon that the Focke-Wulf was making some 380 mph. Thus the combined impact rate would be around 600 mph., and because of the FW's bulk that's a lot worse than the direct hit of a large caliber anti-aircraft shell.

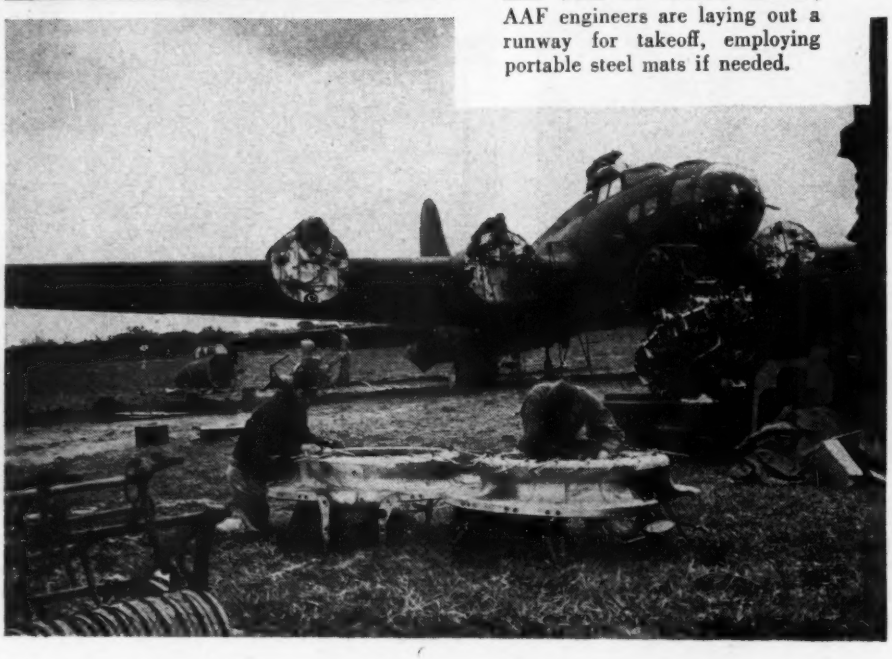
The *Fort's* wing was torn, twisted, and crimped so that not even Boeing's most optimistic aerodynamics expert would have believed the B-17 had a chance. Logical continuation was an unsteady, steep angle dive to the nearest piece of earth. The outboard engine was running rough . . . the inboard one was dead . . . all flying controls were sprung out of line, making maintenance of flying stability a superman job for the pilot . . . and other damage was considerable.

Despite all this, Pilot Edwin R. Manchester, of Wilmington, Del., opened up his remaining engines and set a course for home, instructing his crew to send out flare signals calling escorting P-47's to handle six more FW-190's which were now doing all they knew how to make Tough S—— and her crew permanent casualties.

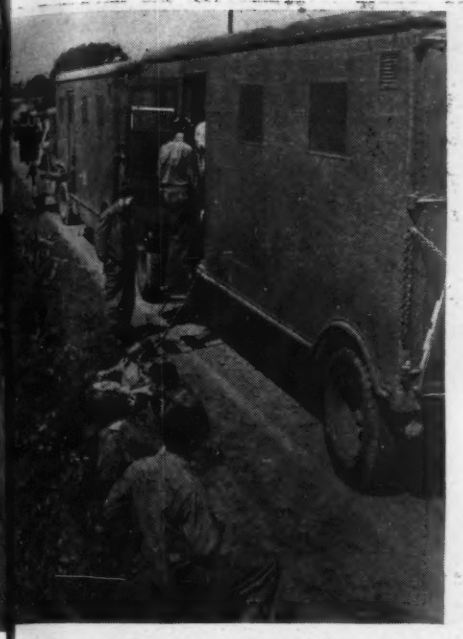
And thus the *Fort* came back to England—not as a lone straggler but still a very definite member of the original family. Throughout, the pilot's feats of strength and skill and the efforts of his crew equalled the amazing stamina of the B-17.

When finally the English coastline appeared, Tough S—— started losing height. The crew decided it was asking too much to make their home airfield, so the pilot selected a potato field and belly-flopped the B-17 as gently as possible. Site of the landing was one of those small English fields which checkerboard the island and which rarely offer more than a few acres, necessitating a belly landing even if the landing gear were working. Damage was so extensive that the B-17 seemed a sure thing for repair at the main depot located over 200 mi.

Interior of parts trailer of a mobile service unit. Here are stored spare parts needed to put damaged planes into flying shape. Units have a "pipe line" from supply depot, which keeps replenishing required parts.



Fourth echelon maintenance in English countryside (above and below). While mobile service men work on downed aircraft, AAF engineers are laying out a runway for takeoff, employing portable steel mats if needed.



Time out for chow. The mobile service unit has complete feeding facilities, its mess rivaling best in service. A sleeping van is also included in unit, with accommodations equivalent to those in any fixed barracks.

Welcome sight to mobile service crews is American Red Cross Clubmobile which stops to serve doughnuts and coffee to hard-working mechanics and technicians.

away. Nevertheless, the central control board's technicians figured a mobile service unit *could* handle the project, and it gave appropriate instructions.

The control board's inspectors arrived at the location ahead of the service unit to make a complete damage report and an inventory of spares to be procured. All this is tricky work. A thorough job is required because inexpert knowledge delays the arrival of spares, replacements, and material. And if some damage is overlooked there's more delay.

Soon a number of vast trucks, resembling a miniature Atlantic convoy, was trundling down the road. Finally this caravan plowed through the surrounding hedge, and with no respect for the farmers' "Dig for Victory" potatoes, took up their positions around Tough S——. Immediately the crew prepared to start repairs.

A complete mobile service unit consists of the following eight vehicles—

1. Large truck and trailer equipped as machine shop with the following tool equipment: Lodge & Shipley toolmaker's lathe, Doall multi-purpose saw, Landis heavy duty universal grinder, Pratt & Whitney universal mill, oxy-acetylene welding plant, tool and cutter grinder, and air compressor unit. Sheet metal tools include beating blocks, a comprehensive supply of small tools, a fitting bench with vises, etc. The truck also carries an electric generating plant to serve the machine tools plus other requirements of the whole camp.

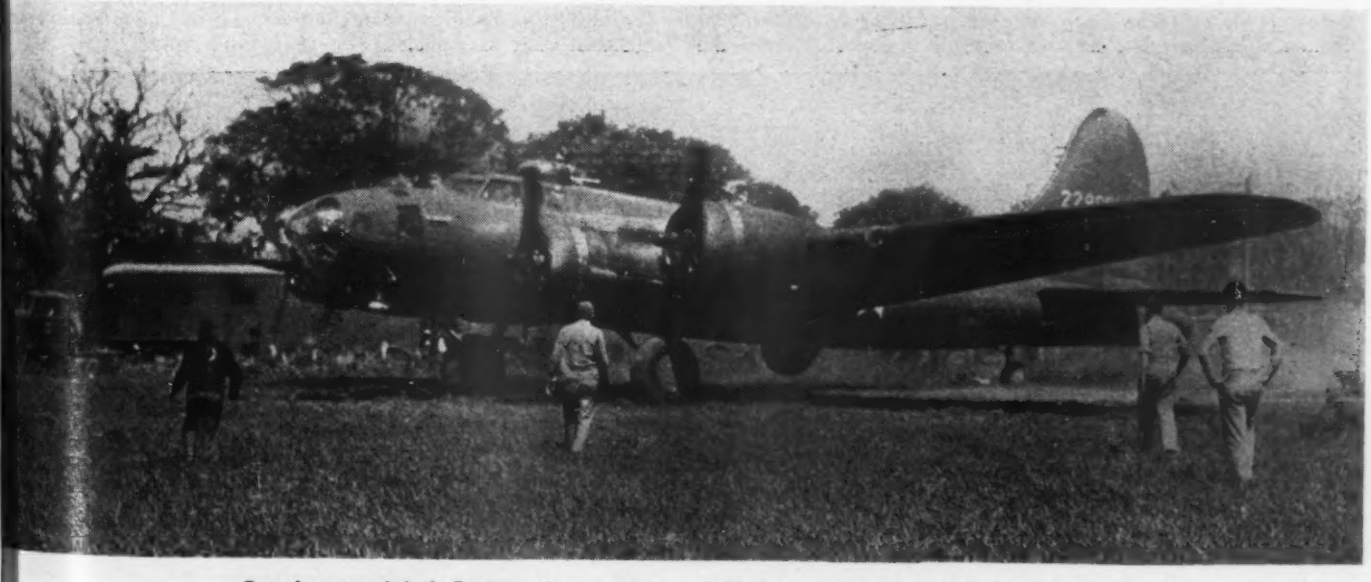
2. Large truck and trailer of similar design fitted out as a store for bar and sheet material, small parts, tools, etc.

3. Large truck and trailer fitted out with a kitchen and a "bedroom" providing bunks for the 19 men who make up the personnel of the unit (13 U. S. soldiers and 6 experts of Lockheed Overseas Corp.). If hotel accommodation is available nearby it is used in preference to the bunks.

4. Two jeeps for collecting necessary material and contacting nearby airfields.

5. One 2½-ton truck for hauling heavy material and transporting personnel.

(*Turn to page* 308)

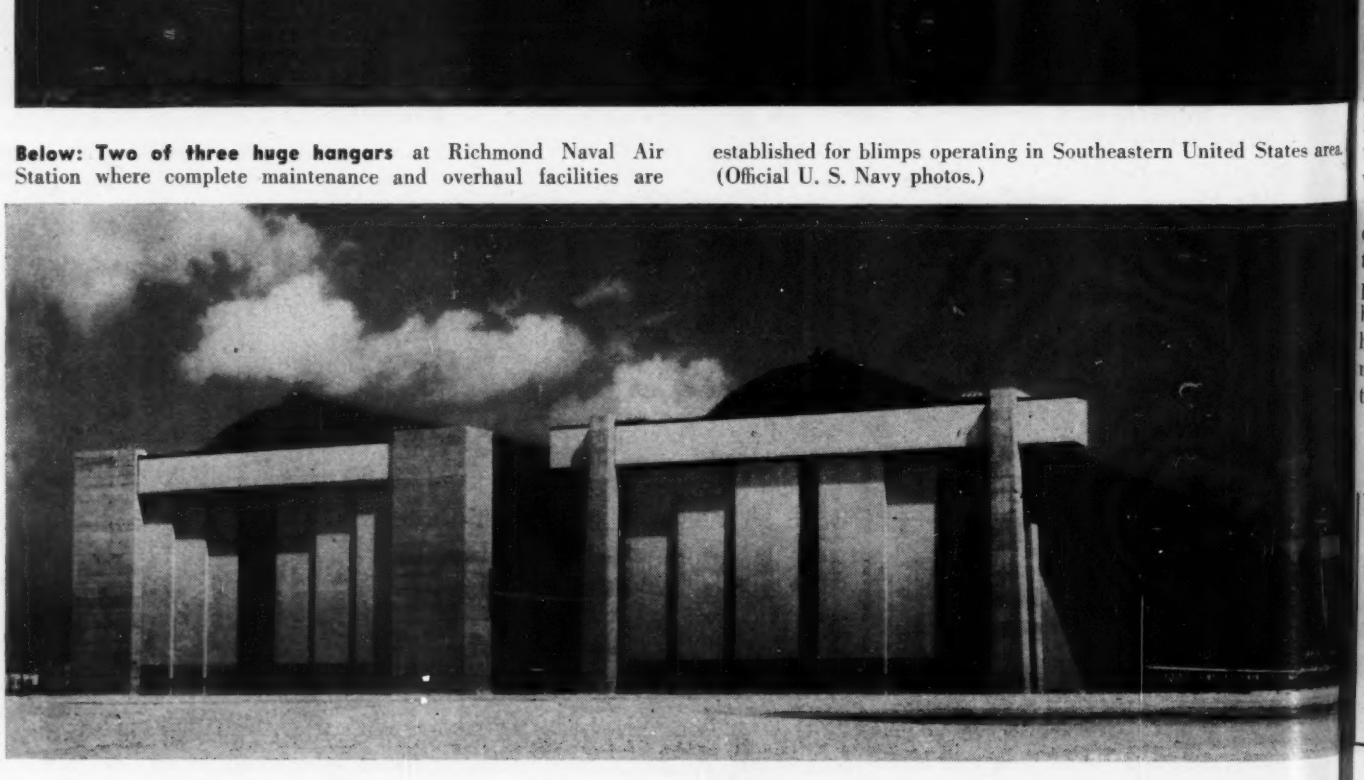


Repairs completed, *Fortress* is taxied across field to temporary runway laid out by Army engineers. Plane will fly back to its base for check flights before being recommissioned.

Maintaining Sub Killers

By LT. COMDR. ROBERT E. HUSE, USNR
Asst. Assembly & Repair Officer, Naval Air Station, Richmond, Fla.

Below: Two of three huge hangars at Richmond Naval Air Station where complete maintenance and overhaul facilities are established for blimps operating in Southeastern United States area. (Official U. S. Navy photos.)



FIRST ARTICLE EVER PUBLISHED ON MAINTENANCE AND REPAIR OF OUR NAVY'S BLIMPS

These craft, key weapons in the successful fight against the submarine menace, are writing one of the truly great stories of the war.

GRACEFUL AND IMPRESSIVE, the great silver airships of the U. S. Navy soar overhead. They are doing their part in winning the battle against the Axis submarines, they are effecting rescues both at sea and on land, and they are carrying out special missions and assignments in connection with their duties as parts and parcels of the United States Fleets.

Day in and day out, and night in and night out, the big helium-filled blimps, with their heroic crews, lift into the skies, unheralded and unsung. Blimps are credited with having performed invaluable services in convoy work; these airships are held in high regard by the Navy and by their companions of the airlanes, the heavier-than-air units.

Complex and interesting is the behind-the-scenes picture of the blimps—the problems of assembly and repair—their overhaul, upkeep, and servicing. Just as there must be at least ten men behind every heavier-than-air pilot, there must be as many, if not more, behind every pilot who flies a blimp. "A & R", the lighter-than-air assembly and repair department, is a closely knit, highly efficient, expertly staffed organization, which has been laboring 24 hr. a day—even as the airships themselves patrolled the skies—to "keep 'em up."

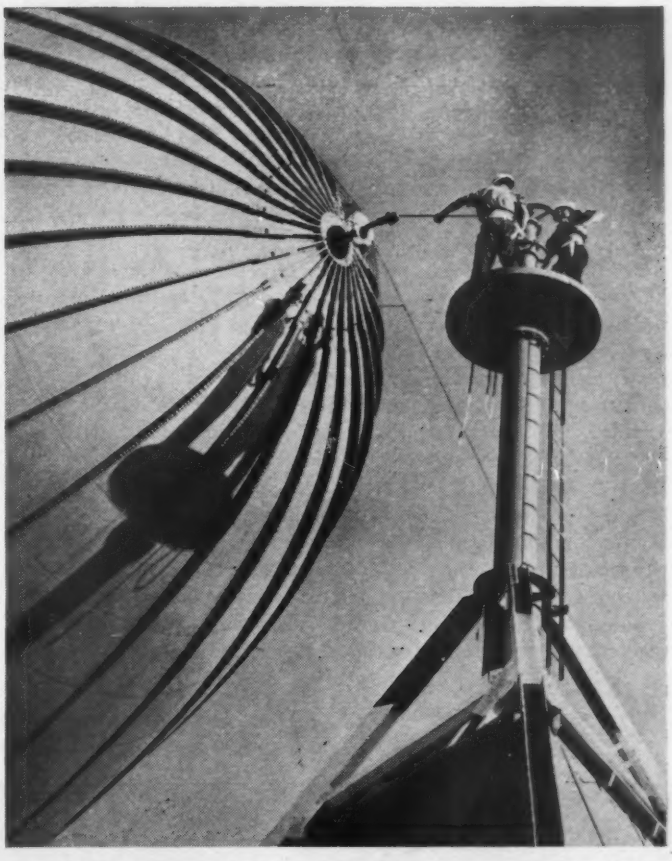
Typical is the A & R Department at the Navy's big new overhaul and operation base at Richmond, Fla. In mid-September, 1942, the Naval Air Station at Richmond was officially commissioned. It was a Naval Air Station in name only, since the 2,100 acres of scrub pine were just another spot in the edge of the Everglades. A landing mat and two runways were hacked out of the wilderness, and the mat was surfaced with easily obtainable coral rock. Even before this was completed, the first airship was ferried in from Lakehurst, N. J. The newly commissioned squadron began operating, making the most of the makeshift facilities available.

In the early days of the station, airships were "masted out" at all times when not actually flying. Handicapped by lack of regular shop facilities, expedient and novel methods were employed to accomplish upkeep and maintenance work while the airships were riding unsheltered to their masts.

A mast watch officer and two enlisted men stayed with each ship, adjusting pressure and ballast as the helium in the large envelopes reacted to the constantly changing atmospheric conditions caused by sunshine, rain, and fluctuating barometric pressures and air temperatures. One of the huge tripod masts was fitted with a bunk-room in which the mast watchers, while immediately available for a call, took turns catching forty winks between watches.

With the squadron thus established and operating, work

This initial detailed revelation of blimp maintenance was written under the direction of Rear Adm. Charles E. Rosendahl, USN, Chief L.T.A. Training Command; Capt. Chas. J. Maguire, USN; Capt. Frank L. Warden, USN, C. O. NAS, Richmond; and Lt. Comdr. J. H. Greenwald, USNR, A & R Officer, NAS, Richmond.



Life-belted crewmen steer nose of a blimp to mooring mast. A line, running down through mast to a winch, is attached to permanent cable secured to blimp's nose. Winch is operated by an electric motor, and airship is drawn to lock at top of mast.

An Atlantic Fleet "K" ship, moored without protection from tropical sun, is "wet down" by a hose arrangement attached to portable mooring mast.

was begun on the first of the three immense wooden hangars to be built. The end was many months away, but the skeleton of a department had been created. An A & R officer was ordered to the station, and a staff of officers, enlisted men, and civilian specialists arrived to form the nucleus of the repair force being assembled. Shops were outlined, equipment ordered, and all of the intricacies of the overhaul and repair of the K-ships were analyzed.

The spirit of "can do" was instilled from the beginning. As the one and only function of the department was to "keep 'em flying," innumerable emergency repairs had to be accomplished at any hour required. Routine engine changes had never before been effected without the protection and convenience of a hangar, but ten Pratt & Whitney 1340 AN-2 aircraft engines weighing close to 1,000 lb. were changed while ships were masted outside.

At first, one engine job per night was all that could be done. But, saying "can do," a unique outside work stand was constructed. With this stand attached to the ship itself, it was finally possible to remove and replace both engines of an airship, run them in, and have the ship ready for a 0500 takeoff (a 5 a.m. flight). Almost every type of emergency repair was handled—including damaged landing wheels, broken tail wheels, and scraped tail fins—in addition to the regular routine checks by the organized and trained lighter-than-air specialists of the night check crews.

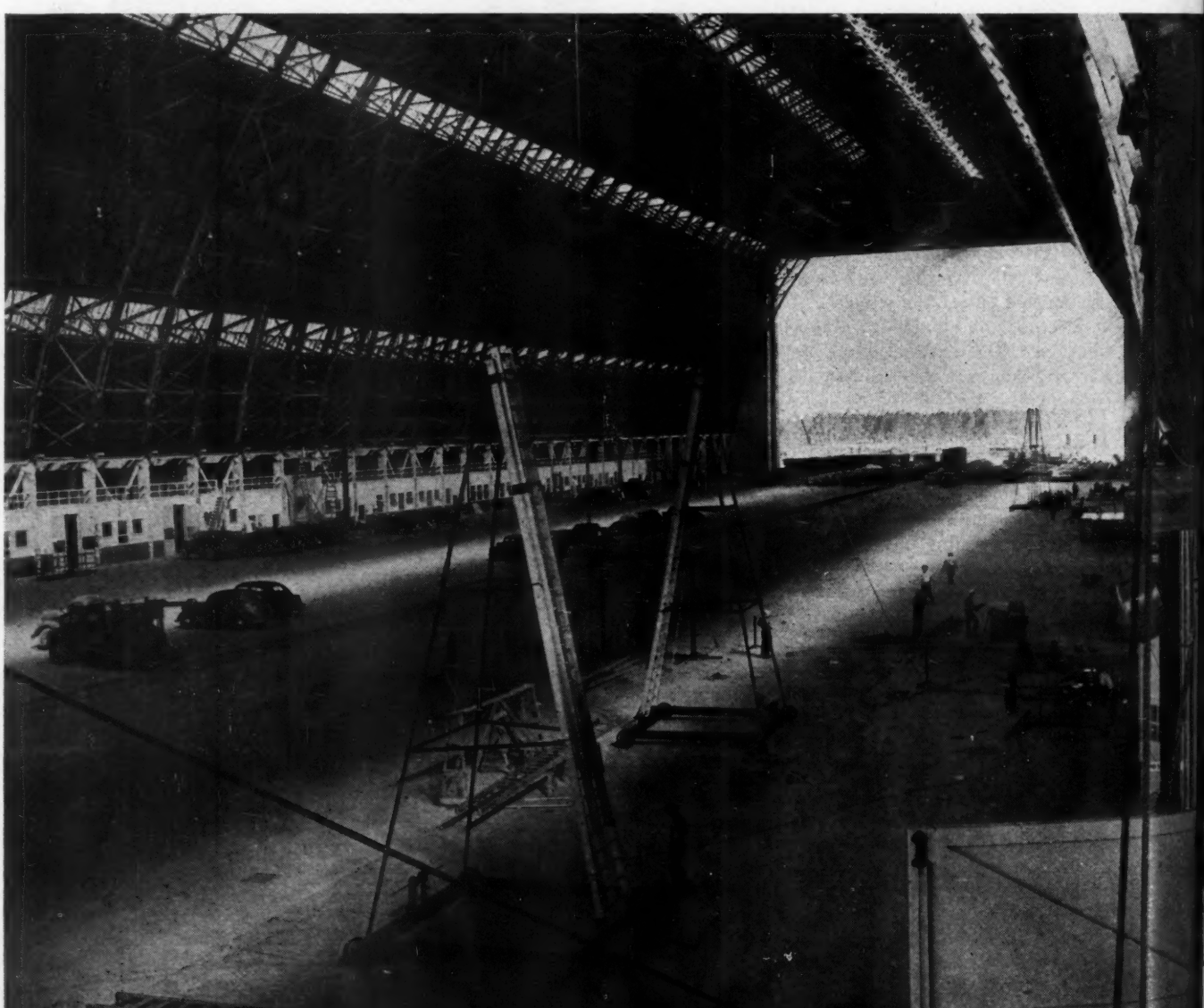
In June, 1943, the structure of the No. 1 Hangar, A & R's home, was completed. Then hangar operations were begun, although machinery and shop equipment were far from complete. The personnel problem was a difficult one. Although every man assigned to A & R possessed an attitude of willingness, interest, and enthusiasm, the majority lacked previous experience or training in airship work. However, this newly formed green crew "turned to" with a will for accomplishment, gaining in experience as interim overhaul of K-ships was begun.

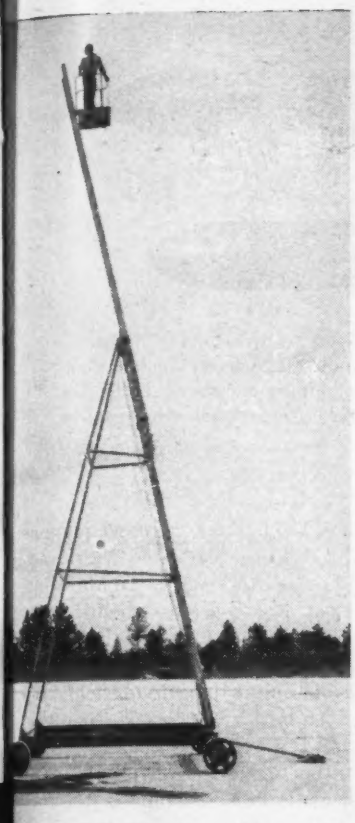
Interim overhauls, scheduled after approximately 1,000 hr. of flight time, require 10 to 14 days to accomplish. As work began, groups of Navy and civilian specialists literally swarmed over all parts of the ship.

Almost all removable gear is taken from the ship and removed to shops for re-conditioning and repair. Radio, special equipment, life jackets and rafts, instruments, major and minor controls, chairs, engines, and accessories, fuel tanks and gages—all are taken to shops having cognizance over them.

The envelope is plumb-bobbed to determine its alignment and whether or not any distortion has taken place. If any

View inside partially completed hangar at Richmond station. Shown in foreground are service ladders constructed by A & R personnel.



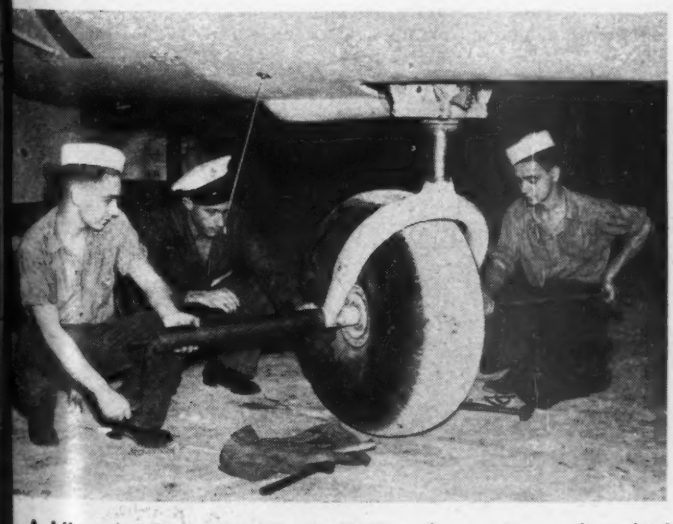


ichmond A & R (Assembly and Re-air) engineers fabricated ladders, uch as one shown here, out of odds nd ends of non-critical materials.

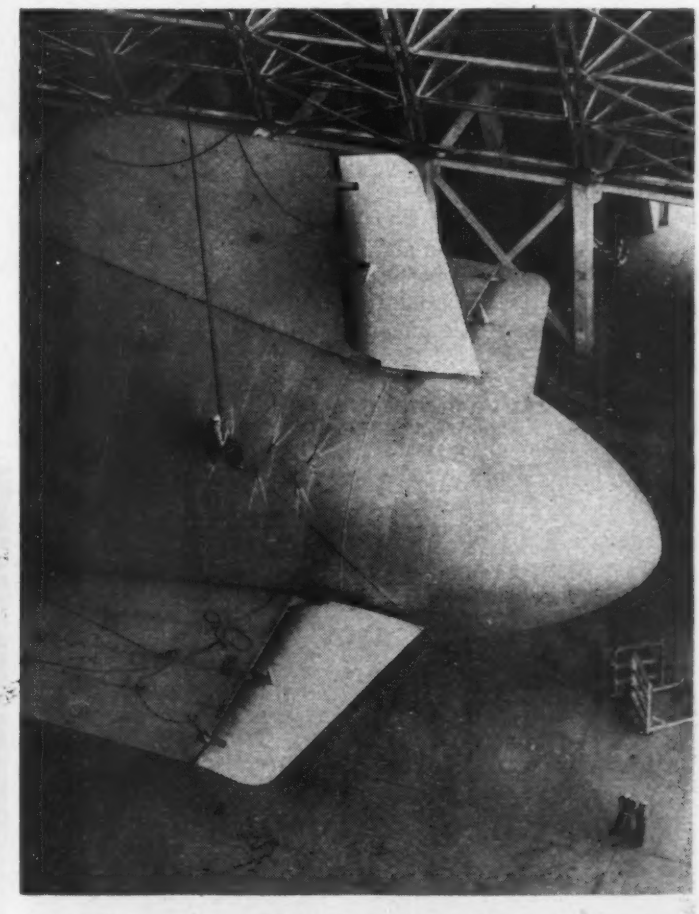
For first time repair crews at Richmond changed blimp engines out in open, with blimp attached to portable mooring mast. Note well-constructed work platform slung from engine nacelle and attached to car. Mechanic (extreme right) is standing on platform which swings out from side of car for servicing engine while in flight.

misalignment is noted, fins are reset to attain the proper flying characteristics. "High-men" work up in boatswains' chairs rigged to the 180-ft. overhead of the hangar. They inspect the top of the envelopes, minutely noting any defects or unusual wear as well as re-tensioning all fin brace wires. A nose crew removes and reconditions the long slender nose battens, and riggers and cable men disassemble the nose mooring assembly.

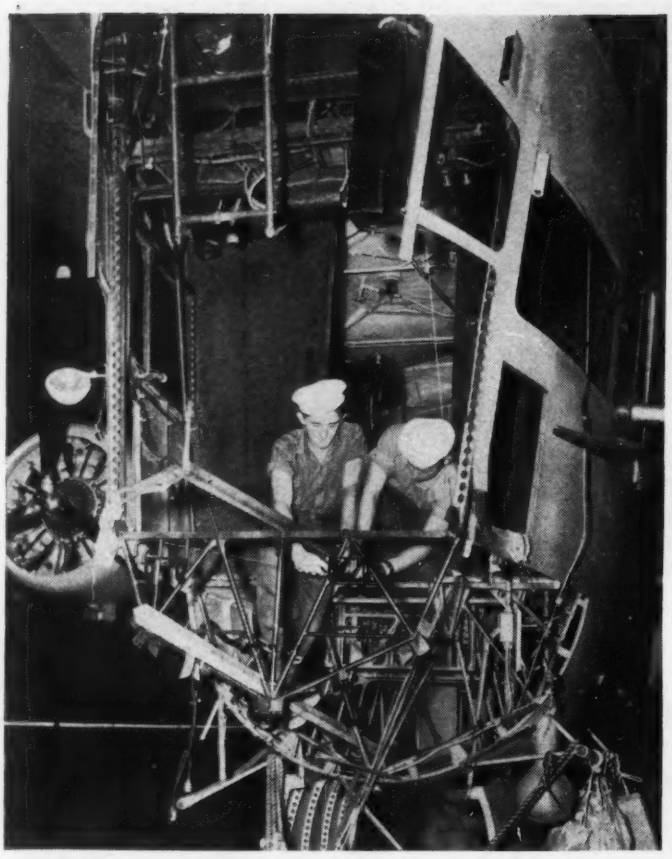
Bit by bit, the airship is completely torn down, and all but the car and bag itself is sent to one or more of the 20 shops that are part of A & R. After necessary checking and servicing, the various parts are returned to the ship



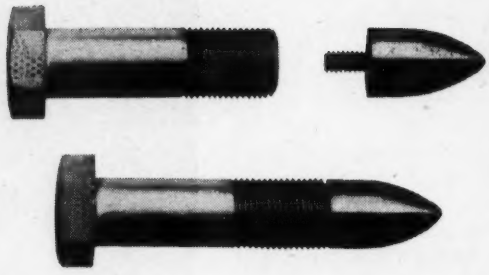
A blimp landing wheel is "pulled" under guidance of a chief aviation machinist mate. Bearing full weight of huge airship, wheels require careful checking and inspection.



Inspecting a K-type blimp. Inspecting sailor is swinging in a bosun's chair some 150 ft. above hangar deck. He is held steady and maneuvered by his mates far below.



A & R members effect emergency repairs on damaged nose of a blimp car.



Special purpose bolt developed by Richmond A & R technicians to take care of not-quite-aligning bolt holes. Complete bolt is driven through joining members, bullet-like guiding tip is unscrewed, and bolt is secured with a nut in regular manner.

and reconstruction is begun. When painting and Plexiglas work is completed, the various parts of the ship are re-assembled and the finished product takes form. Finally, after completion of all the required work, the dock trials of the ship are begun. Valves are tested for proper calibration, engines are run in, fuel, oil, and electrical systems are checked. Then expert inspectors finally pronounce the ship ready for a test flight.

Although "lighter-than-air" is the designation for the large patrol blimps, supported by the static lift of the helium gas, actually they are usually flown initially heavy. Consequently, they must take off and sustain themselves in flight aided by the dynamic lift gained from their forward motion and airspeed. For this reason, the ship is ballasted with sand so it is about 1,500 lb. heavy for its test hop. In the dim light of early morning, the test crew climbs aboard and the ship is undocked from the hangar by a ground handling party of 40 to 60 men.

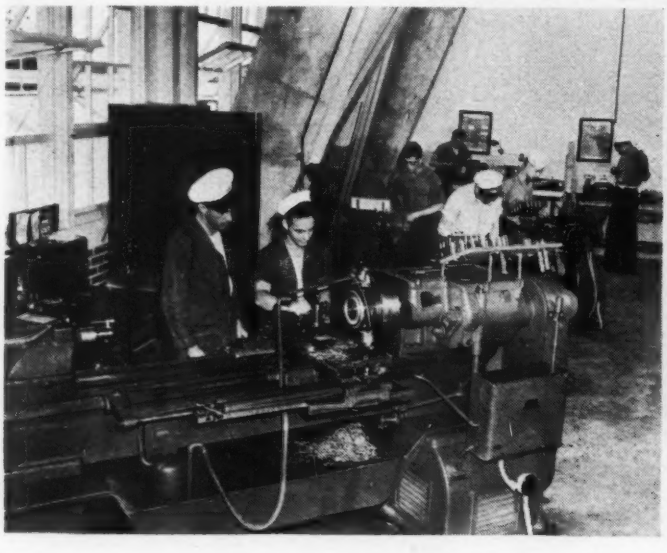
After being spotted for the maximum length of field for the takeoff, the nose mooring pendant is released from the mast, the mast is hauled away, and the ship weighed-off. All lines slack, and with the car untouched, the trim of the ship is determined—nose heavy, tail heavy, or in trim. After the proper trim is obtained, the pilot clears his engines and signals to the ground handling officer for takeoff. Held into the wind by two short lines, the huge ship gradually picks up speed, and after a 500 to 1,000-ft. run it is airborne.

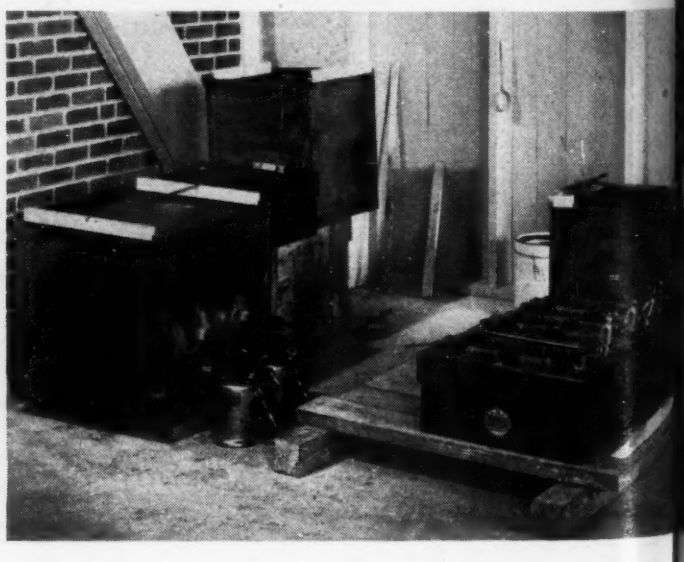
Once in the air, the real tests begin. Rate of climb and descent at various engine speeds are tried to assure the strength and stability of the huge ship. Then speed trials are run: The amount of elevator needed to fly at constant altitude is noted for each speed range. Radio, special equipment, life jackets and raft, bomb releases, and machine guns are tested.

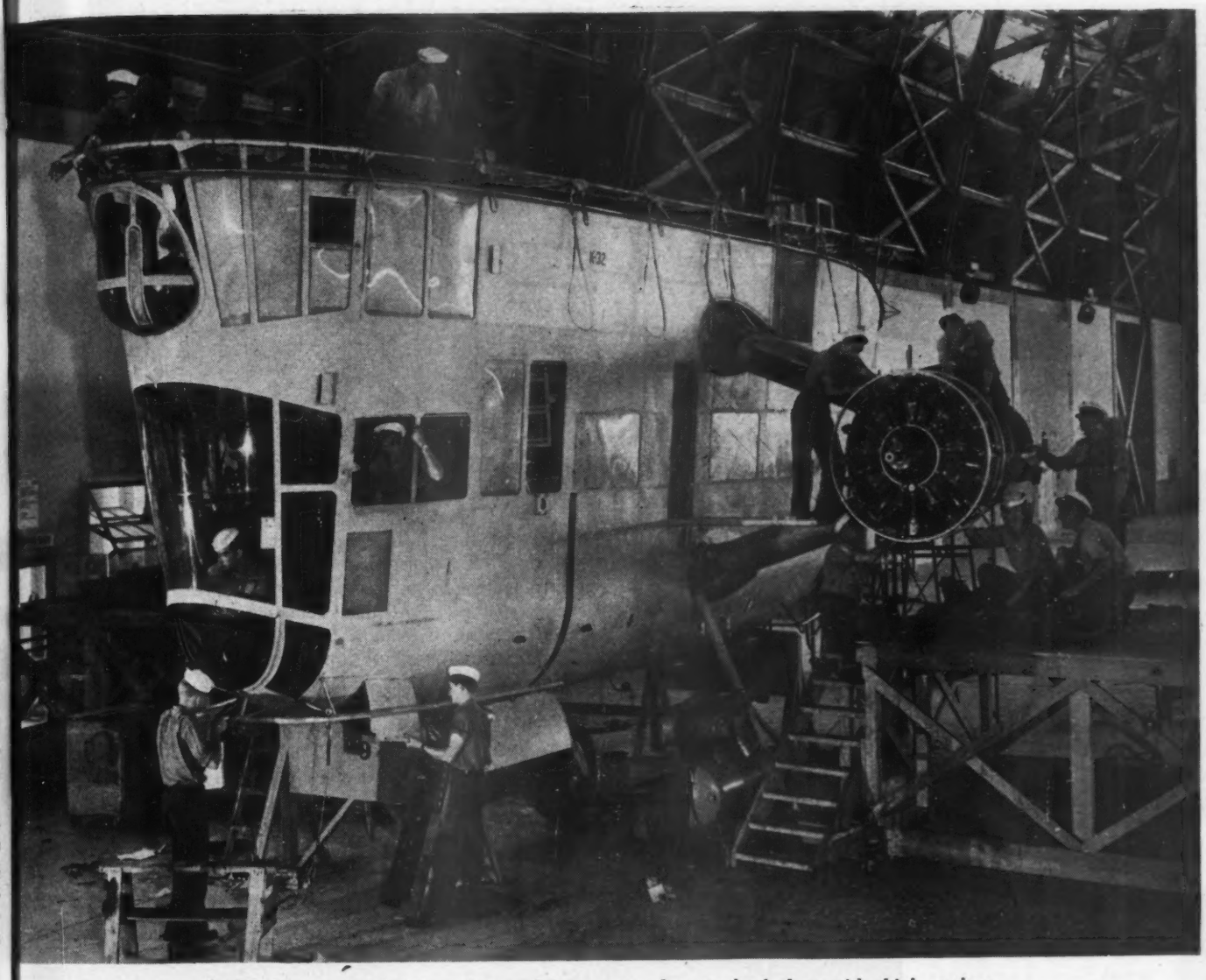
Next, the sand ballast is dumped out and the flight characteristics are carefully noted for all conditions, from the original degree of heaviness to equilibrium. Finally, with the ship in equilibrium and engines throttled all the way back, the trim of the ship is noted.

With all of this data assembled, the ship is flown back to the base and nosed down for a landing. With almost

There is all kinds of equipment to do job. Seen are late-model engine lathe in machine shop at Richmond, and improvised electro-plating set-up using batteries for current, and two blow torches for cadmium and chrome plating and anodizing.



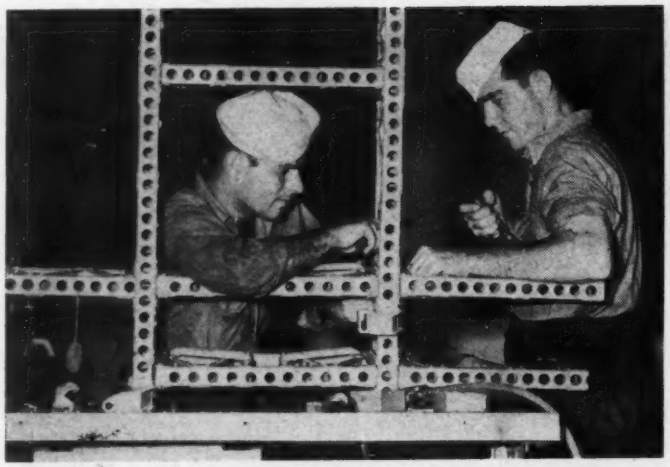




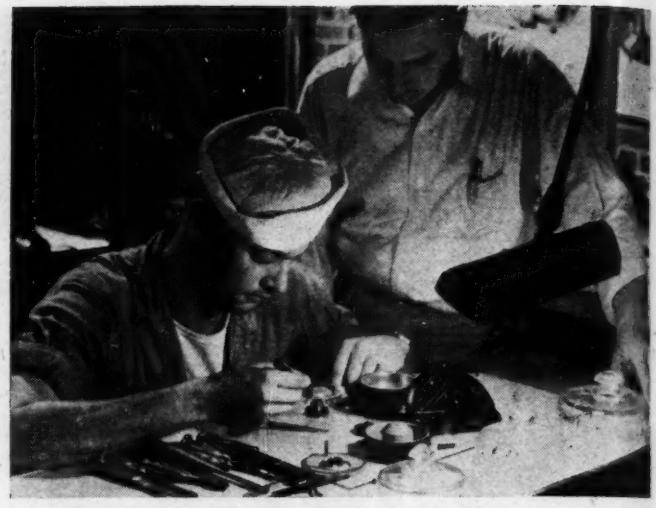
A blimp's car, detached from bag, undergoes a complete overhaul along with ship's engines.

Fabric repair shop is one of most important in line of shops at Richmond. Sailors and civilians work together in cutting and fitting fabric, fabricating sandbags and other items connected with blimp operation and maintenance.

Jig for repairing metal nose of a Navy blimp at Richmond.



Aviation metalsmiths repairing framework of a blimp's car.

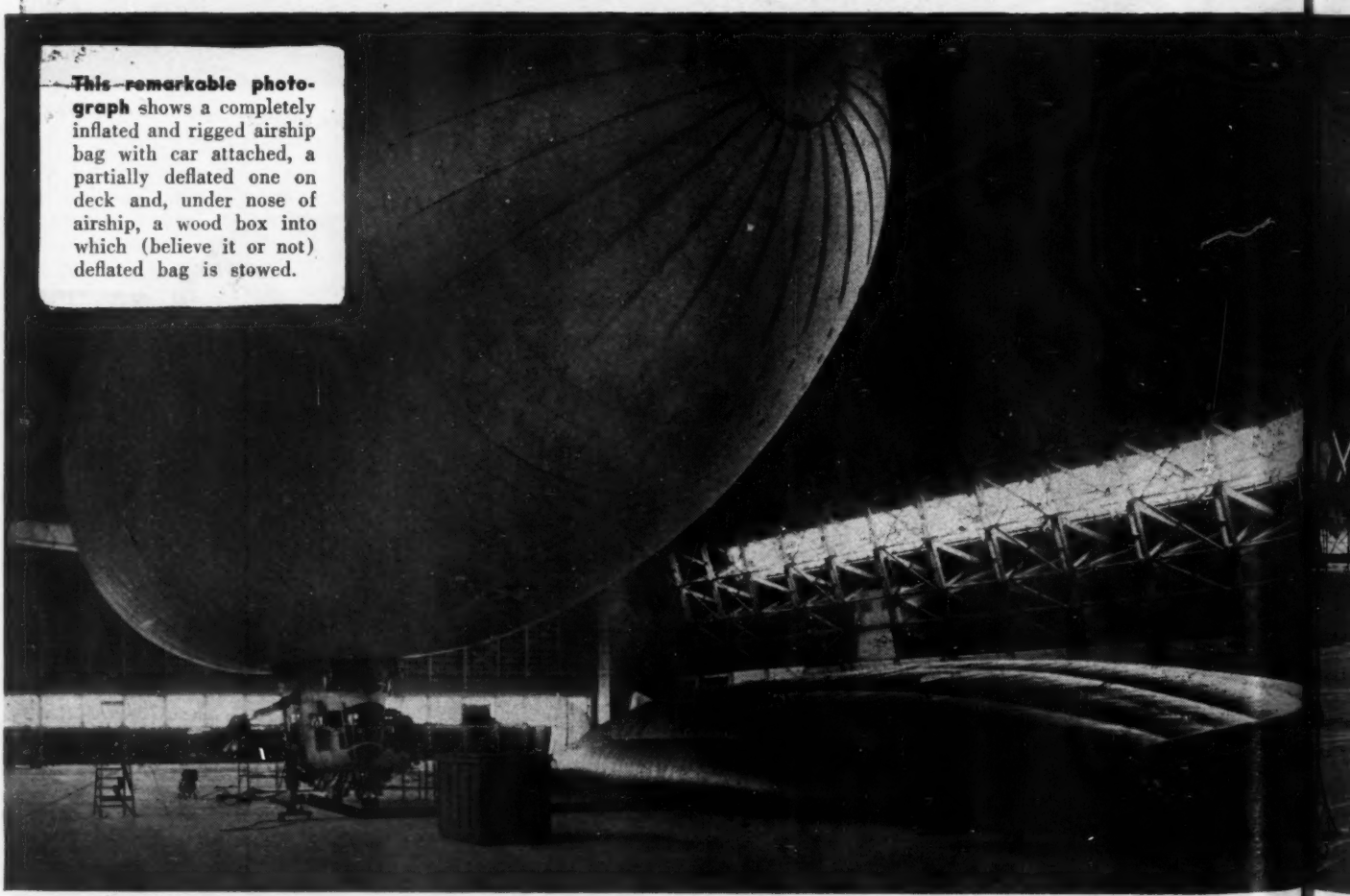


Expert craftsmen repair and service all instruments at Richmond.

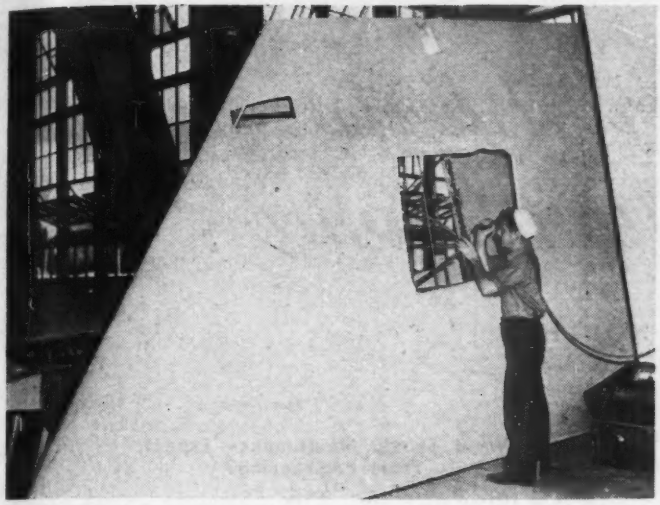
Checking balance of propellers used by Navy blimps.

no forward speed, the ship hovers over the field, and the "long lines" are dropped to the ground handling party. The ship is hauled down, masted, then re-docked.

Once docked, the final touching-up is begun. Data collected on the test flight is analyzed—and the production superintendent, overhaul superintendent, and test pilot are informed as to changes or improvements to be made. Readjustment of control surfaces, re-tensioning of suspensions, or perhaps minor adjustments of controls or instruments, are decided upon and made. The ship is then fueled and turned over to the fly-away crew, perhaps to go to a closeby station or perhaps to make a series of long hops to a remote advance base. It may not be inside of a hangar again for months.



This remarkable photograph shows a completely inflated and rigged airship bag with car attached, a partially deflated one on deck and, under nose of airship, a wood box into which (believe it or not) deflated bag is stowed.

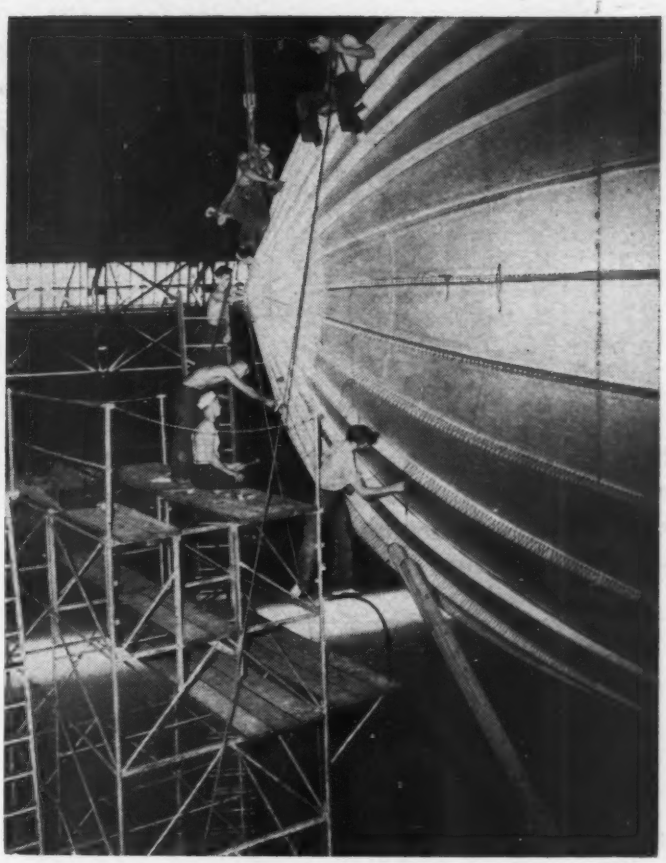


This sailor is making repairs on tail fin of a Navy blimp after a portion of fabric covering has been cut away to reach metal.

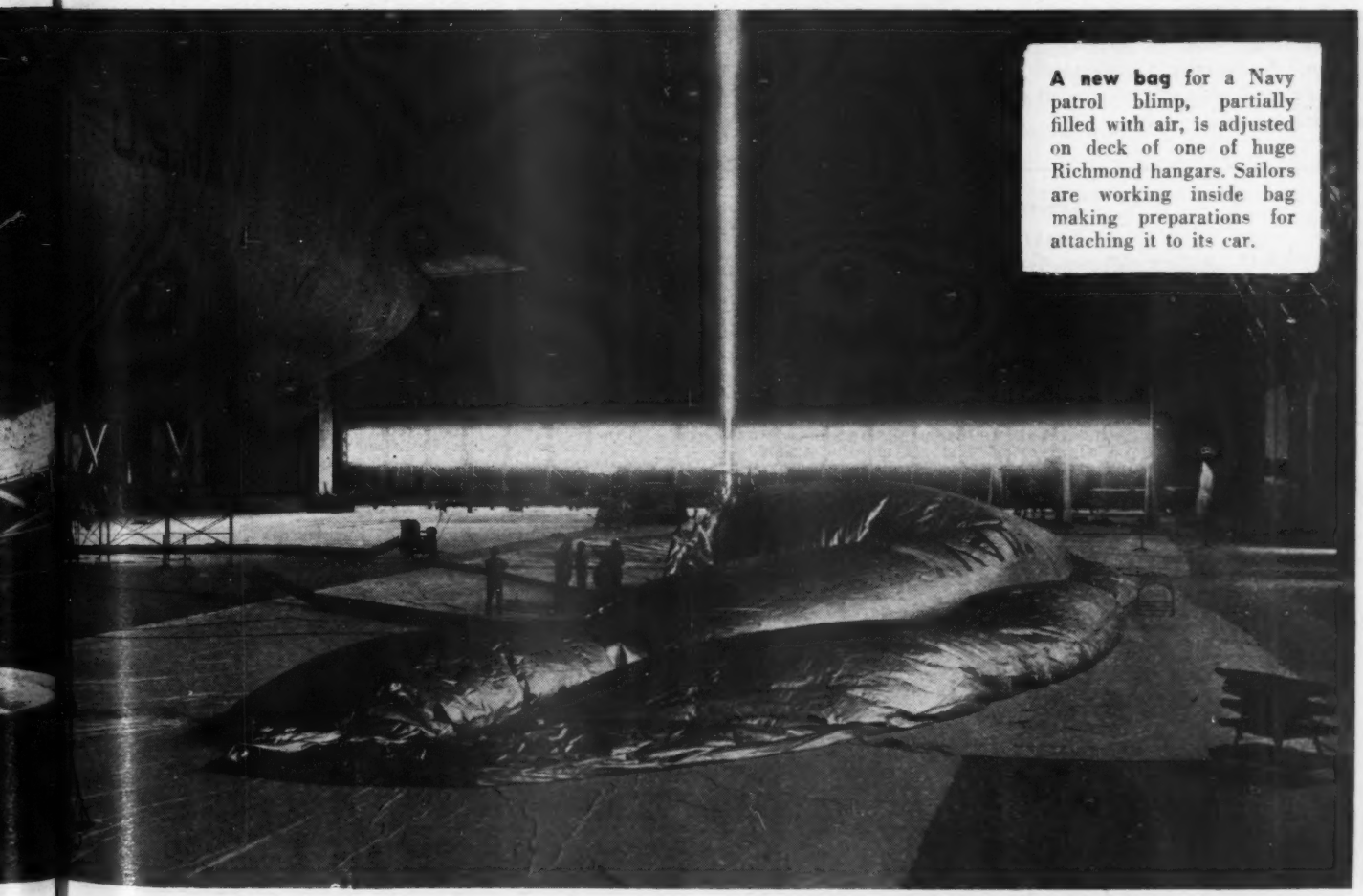
With the establishing of headquarters squadrons (blimphedrons), A & R is becoming more concerned with major overhauls, emergency repairs, and the manufacture of repair parts and changes, both for their own department and for hedrons.

Major overhauls, undertaken after approximately 3,000 hr. of flight time, consist of a complete renovation of the whole ship, including removal of the envelope and installation of a new or reconditioned one. The preliminary work consists of laying out a 300x100-ft. ground cloth on the deck. The ship is then spotted over the ground cloth on the deck

(*Turn to page* 321)



High up on rigging constructed at Richmond, A & R crews work on nose of a blimp. Here they are securing wood former stays which radiate symmetrically from metal nose piece.



A new bag for a Navy patrol blimp, partially filled with air, is adjusted on deck of one of huge Richmond hangars. Sailors are working inside bag making preparations for attaching it to its car.

Engineering Aspects Of Airline Maintenance

By **DAVID NORTH,**
Engineering Dep't. American Airlines

Indispensable factor in successful operation of airlines is cooperation between engineering and maintenance departments. Described is the AA way of effecting this service.

A MODERN AIRLINE cannot function without a maintenance department; nor can an airline maintenance organization keep up with modern technical developments without engineering facilities. It is the purpose of the author to show how cooperation between maintenance, with its eyes on today, and engineering, looking towards tomorrow, can combine to give highest service and efficiency.

Both maintenance and engineering are primarily service organizations in a successful airline. One has the duty of providing the operating branch with airplanes—when and how it wants them. The other has the duty of providing maintenance with the technical data needed to accomplish that service goal. It can, then, be said that maintenance work is 75 percent action and 25 percent analysis, while engineering work is 75 percent thought and 25 percent action. Essentially, maintenance is the doer, engineering the thinker, and both are successful only to the extent that they provide genuine service.

What Should Maintenance Expect From Engineering?

This is a prime question. First, maintenance can expect to get the facts, analyses, opinions, and constructive answers to any of the questions that arise in the maintaining of aircraft and their accessories. If an answer has not been found, a reasonable investigation is in order within the scope of the engineering department concerned. If the answer is not obtainable, the department should provide service at least by referring to the manufacturer of the item or to the proper higher authority, thereby providing maintenance with the facts as soon as available.

It is the responsibility of engineering to provide up-to-date information on new developments in the industry, weeding out those ideas that are unsound and presenting those that are truly progressive in the form most suitable for practical application. New ideas are the basic business of an engineering department, whereas they are only a by-product of a maintenance department's duties.

Not only has engineering the duty of providing information and procedures upon request, but also it has the privilege of making independent surveys of problems which, in its opinion, are not being successfully combatted. Improvements resulting in weight savings, lower costs, higher efficiency, use of less critical materials, and time saving fall within this category. Often an alert engineering organization

Typical example of work flow between maintenance and engineering.

MAINTENANCE

8–22–43 *Buffalo*—Maintenance service report indicates that DC-3 was delayed 33 min. because left propeller dome leaked oil. To lessen delay, equipment was changed.

8–27–43 *New York*—Maintenance service report indicates that DC-3 was delayed 39 min. because left propeller dome was found to be leaking oil prior to engine run-up. Ship was brought into hangar to install new propeller valve gasket and rework propeller dome seal.

9–14–43 Maintenance investigator received copies of above service reports and others indicating similar trouble and ordered a survey of past six months' troubles with leaking propeller domes. Findings:

Mar. 1	June 4
Apr. 1	July 6
May 0	Aug. 18

This summary indicates that the situation is growing serious. He therefore notifies director of maintenance of his findings.

9–15–43 Director of maintenance informs his department to be on the lookout for this malady and requests that attention be given to finding a solution. Maintenance issues a "request for engineering service" to engineering, assigning the project a high priority and at the same time concentrating on studying the symptoms of the problem.

ENGINEERING

9–16–43 Chief engineer receives the "request for engineering service" and assigns the project to the power plant engineer giving the job a job order number and highest priority.

ENGINEERING & MAINTENANCE

9–17–43 The project engineer in charge of power plant begins a study of the problem and a review of the past history of the case. His investigation naturally leads him to discuss the problem with the maintenance men who are most closely associated with the trouble. The maintenance men in the engine overhaul department propose what they believe is the solution to the difficulty—an aluminum spacer to be used in conjunction with the standard propeller dome seal. The engineer approves the principle of the idea and it is decided to give it a service test. Since it is a departure from standard practice, the engineer contacts the Civil Aeronautics Authority for approval and after approval is received, he writes an engineering release calling for a service test of the new type propeller dome seal on a limited number of DC-3 airplanes.

MAINTENANCE

9–24–43 Maintenance receives the release authorizing a service test and makes the required number of installations. During the test period, maintenance keeps close watch of the progress of tests and writes a summary of the results for the benefit of the project engineer.

ENGINEERING

10–24–43 Since the results of the service tests are favorable, the project engineer writes a new engineering release authorizing the use of the new technique on all DC-3 propellers.

MAINTENANCE

11–14–43 The maintenance investigator continues his analysis of the problem and finds from service reports that the frequency of occurrence of propeller dome oil leaks has fallen off from 18 in August to 8 in September which trend indicates that as soon as all propellers are converted, the problem is solved.

will discover a solution to a problem even before it is recognized as one.

And in all cases, maintenance has the right to expect that information issued by engineering will be in writing or drawings prepared so that they present practical ideas in terms readily understandable by those who act upon them. This is accomplished by a system of engineering releases, accompanied by drawings when necessary. These engineering releases are definite commitments by the department and can only be modified or cancelled by subsequent engineering releases.

What Can Engineering Expect From Maintenance?

On the other side of the picture, engineering has the right to expect strict observance of the specifications and procedures it has issued, even down to the minutest details. If the plans as specified do not work, the engineer must be promptly informed.

This is especially true on trial installations of a design. If discrepancies, even minor ones, are not reported, they soon develop a condition where the engineer is thinking about one thing and the mechanic is doing another. A state of affairs such as this often will proceed smoothly for quite a period—until the spell is broken by either the mechanic or the engineer being shifted to another job. Then the newcomer, in trying to follow the uncorrected plans, finds himself in the middle of a confusing muddle.

Mechanics and their supervisors have golden opportunities to discover improved methods by experience. Their eyes must always be open for short-cuts, time-saving devices, labor-saving methods, and means of prolonging the service life of equipment. When they discover these improvements, they are expected to keep their engineering department informed. Only with this cooperation can the engineer keep his designs and specifications in line with practice.

A suggestion system consisting of an attractive form and a system of numbered stubs to avoid the use of names in judging the merits of a new plan is a convenient and equitable method of gathering ideas from the rank and file of employees. With this system it is also possible to reward the originators of truly inventive ideas without the risk of showing favoritism. New methods and techniques discovered by maintenance supervisors should also be promptly transmitted to engineering by means of correspondence or requests for engineering action so as to help the engineering department keep informed of existing conditions.

It cannot be emphasized too often that the actions of maintenance in following the plans and specifications of its engineering body must be executed with precision and strict attention to detail. Half-hearted observance of rules of procedure have no place in a well managed maintenance organization. The quality of workmanship can best be controlled by adequate and intelligent inspection.

In every instance, the airworthiness of the *design* is the responsibility of maintenance. A good engineering department expects that a good design will be translated by the maintenance department into a good installation resulting in an airworthy airplane. Furthermore, it can expect that the airplane will be maintained in such a way as to stay airworthy.

AMERICAN AIRLINES, INC. AMAIR E1 REV.-9-1-43-3M—S

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EDITOR—OPERATING EQUIPT. MANUALS

ENGINEERING DEPARTMENT
RECOMMENDED ENGINEERING CHANGE OR PROCESS SPECIFICATION

MAINT. DEPT. EQUIP. CHGE. NO. ____
DATE RELEASED TO FIELD ____
EXECUTED INVENTORY REC. FORM ____

DATE OCTOBER 25, 1943
ENG. RELEASE NO. DC3 - 1948 - 01:00
SUPPLEMENTS
**SUPERSEDES RELEASE NO.

SERVICE TEST	X	INSTALLATION CHECK	
PRODUCTION		CANCELLATION OR CORRECTION	
DRAWING REVISION		PROCESS SPECIF.	
APPROVED REPAIR		CONFIRMATION	
SEASONAL CHANGE		PERIOD PARTS REPL.	
STANDARDIZATION		INTERCHANGEABLE PARTS	
REMOVAL		FACTORY STD. STARTING	
PRIORITY	RUSH	TIME OF O'HAUL	C-46
CAA 18-1 REQUIRED		LICENSE	

REQUESTED TO BE MADE ON: AIRPLANE COMPANY NOS. OR OTHER EQUIPMENT MANUFACTURERS SERIAL NOS.
ONE DC-3 AIRPLANE ONLY

CLASSIFICATION: DEICER SYSTEM
SUB CLASSIFICATION: WING SURFACES

CHANGE: INSTALL FOR SERVICE TEST ONE SET OF WING DEICER BOOTS USING IMPROVED INSTALLATION METHOD AS OUTLINED IN ATTACHED INSTRUCTIONS

REASON—REMARKS:
TO REDUCE TIME AND LABOR OF INSTALLATION, AND TO INCREASE SERVICE LIFE

PERIOD OF TEST: ONE ENGINE OVERHAUL PERIOD

INFORMATION TO MAINTENANCE AND STOCK CONTROL ON DISPOSITION OF PRESENT INSTALLED PARTS, PARTS ON ORDER, STOCK, AFFECTED BY ABOVE ENGINEERING CHANGE: ALSO NEW PARTS PLANNING & PROCUREMENT.
BY SPECIAL ARRANGEMENT, SERVICE TEST PARTS WILL BE RECEIVED FROM MANUFACTURER ADDRESSED TO PROJECT ENGINEER DIRECT

MANUFACTURE AND INSTALLATION TO BE SUPERVISED BY: ENGINEERING DEPT.
REQUESTED BY: MAINTENANCE
DEPARTMENT: DATE
ESTIMATED WEIGHT CHANGE: + NONE LBS. / — — LBS.
ESTIMATED COST—SPECIAL INSTALLATION . . . $ UNKNOWN
ESTIMATED COST—PRODUCTION INSTALLATION $ (ABOVE FIGURES FOR 1 AIRPLANE—ENGINE—)
AUTH. NO. DATE OF APP.
APPROVED: CHIEF ENGINEER ENG. DEPT.
APPROVED: DIRECTOR OF MAINTENANCE DEPT.

DRAWINGS, SKETCHES, REPORTS, SPECIFICATIONS APPLYING (ARE) (ARE NOT) ATTACHED. REFERENCE TO PERTINENT CORRESPONDENCE OR MANUFACTURER'S SERVICE BULLETIN REGARDING ABOVE ENGINEERING CHANGE OR PROCESS SPECIFICATION NOTED BELOW.
CDS - 1066 INSTALLATION DRAWING
3 PAGES OF INSTALLATION INSTRUCTIONS

(FOR ENGINEERING DEPARTMENT USE ONLY) CIVIL AERONAUTICS APP: DATE 10-22-43 MANUFACTURER'S APP: DATE 10-22-43

MAINTENANCE TO CONTACT PROJECT ENGINEER WHEN JOB IS ABOUT TO BE STARTED

*THIS IS TO ADVISE YOU OF CHANGES AND/OR TESTS BEING CONTEMPLATED OR MADE ON EQUIPMENT OF YOUR MANUFACTURE OR DISTRIBUTION. FURTHER DETAILS, AND/OR DRAWINGS WILL BE SUPPLIED ON REQUEST.
**A SUPERSEDING RELEASE CANCELS THE PREVIOUS RELEASE UNLESS OTHERWISE INDICATED. ENG. REL. NO.

Form used for recommending changes in engineering or processes.

Maintenance and Engineering Liaison

To achieve that close cooperation required between the designer and the mechanic, an intermediary is required who knows a lot about both maintenance and engineering. This function is usually filled by a liaison engineer. Since in an airline, maintenance works around the clock every day in the week, while engineering works most productively on a 40 to 48 hr. week, the job of liaison engineer is further complicated, two or three shifts often being needed to give adequate coverage.

In brief, the duty of liaison engineers is to use their brains as well as their feet to see that information coming off the drafting board is translated into correct construction by the workman on the job. The liaison engineers are charged with the responsibility of picking up and straightening out the little misunderstandings between maintenance and engineering that usually arise with a new design or procedure.

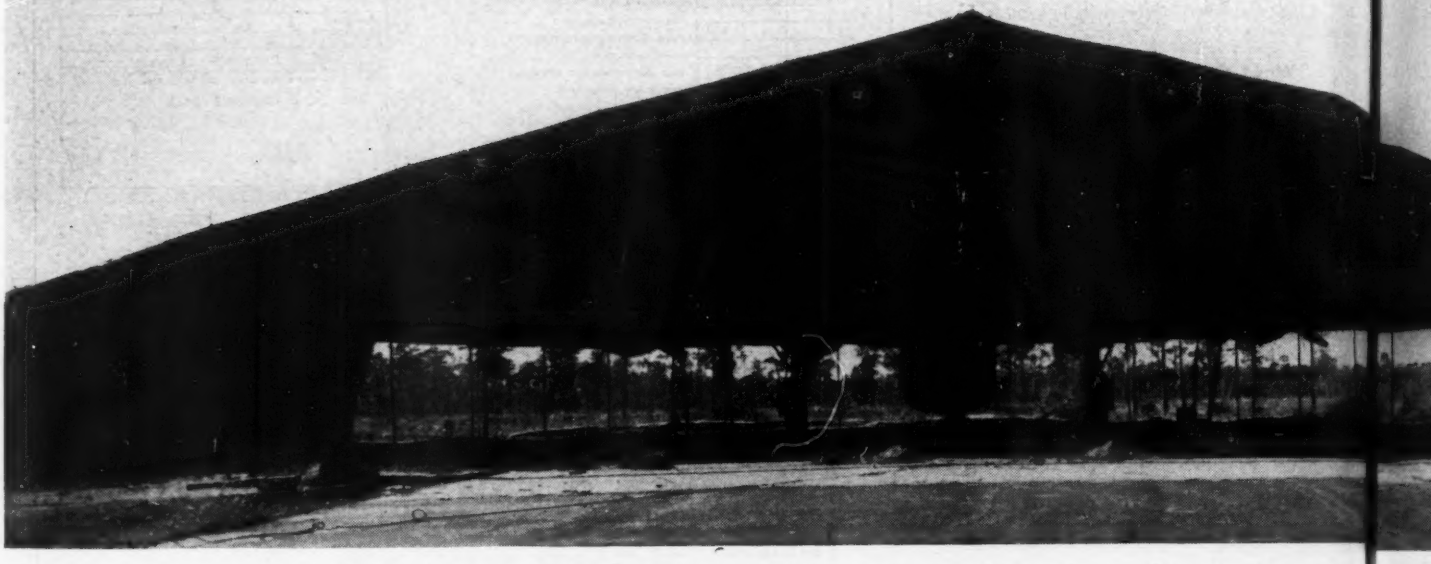
The "Route" Of an Idea

Next, let us observe the routing of a new aeronautical idea from conception to completion. Let us look at the work flow chart of a technical improvement in the method of attaching rubber de-icer boots to the wings of a DC-3 air-

(*Turn to page* 344)

They're Trained to

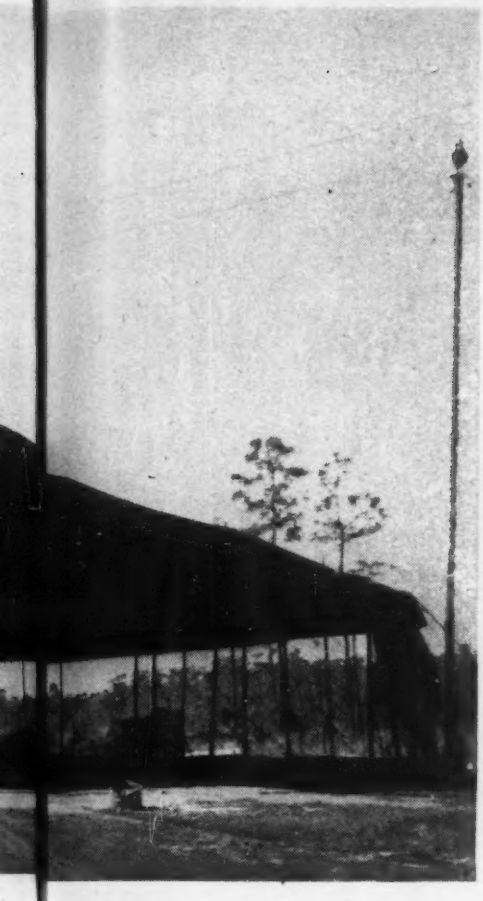
Fix It Under Fire



Built like circus "big top" this 120-ft. wide portable hangar houses largest bombers. It can be erected in six hours. (All photos by AAF.)

Work under realistic combat conditions is accented at AAFSATS' "graduate" school in the art of putting planes back on the battle line. Here, crewmen get a double-tough "fighting" curriculum—one which trains them to fight through on any maintenance job and to fight off any enemy aiming to stop them.

Under combat conditions, crew (left) works on engine while mechanic (right) checks engine installation.



With mobile tool unit alongside, mechanics complete engine change on P-40. Note light sheet-metal platform braced for stiffness.

Mobile repair units have complete electrically-operated shop equipment. Provided are current and compressed air for hand tools and supply of small parts.

First echelon maintenance is minor work done by pilot, in emergency, or by ground crew. Included are engine adjustments, testing of equipment, and small repairs.

Engine change on P-51. Technician (right) points out defects in accessory just removed from engine. Note cap on prop shaft to protect threads.

BATTLE-HARDENED VETERANS are carefully training mechanics at the Army Air Forces School of Applied Tactics, where simulated combat conditions modify peacetime methods of maintenance.

There is no dividing line between the work of different echelons under combat conditions. During action, fourth echelon, which usually does only heavy overhaul and rebuilding, may do line servicing and inspection, which is supposed to be first echelon work. Similarly, first and second echelon do not hesitate to do overhaul and rebuilding if it is required and they have the facilities. Indeed, they quite frequently handle tasks on the practical premise that they possess the ingenuity for the work, despite lack of the equipment which normally would be considered essential. As it is customary in the field to use the nearest repair unit, AAFSAT mechanics don't worry about which echelon is supposed to do the work—they just do it.

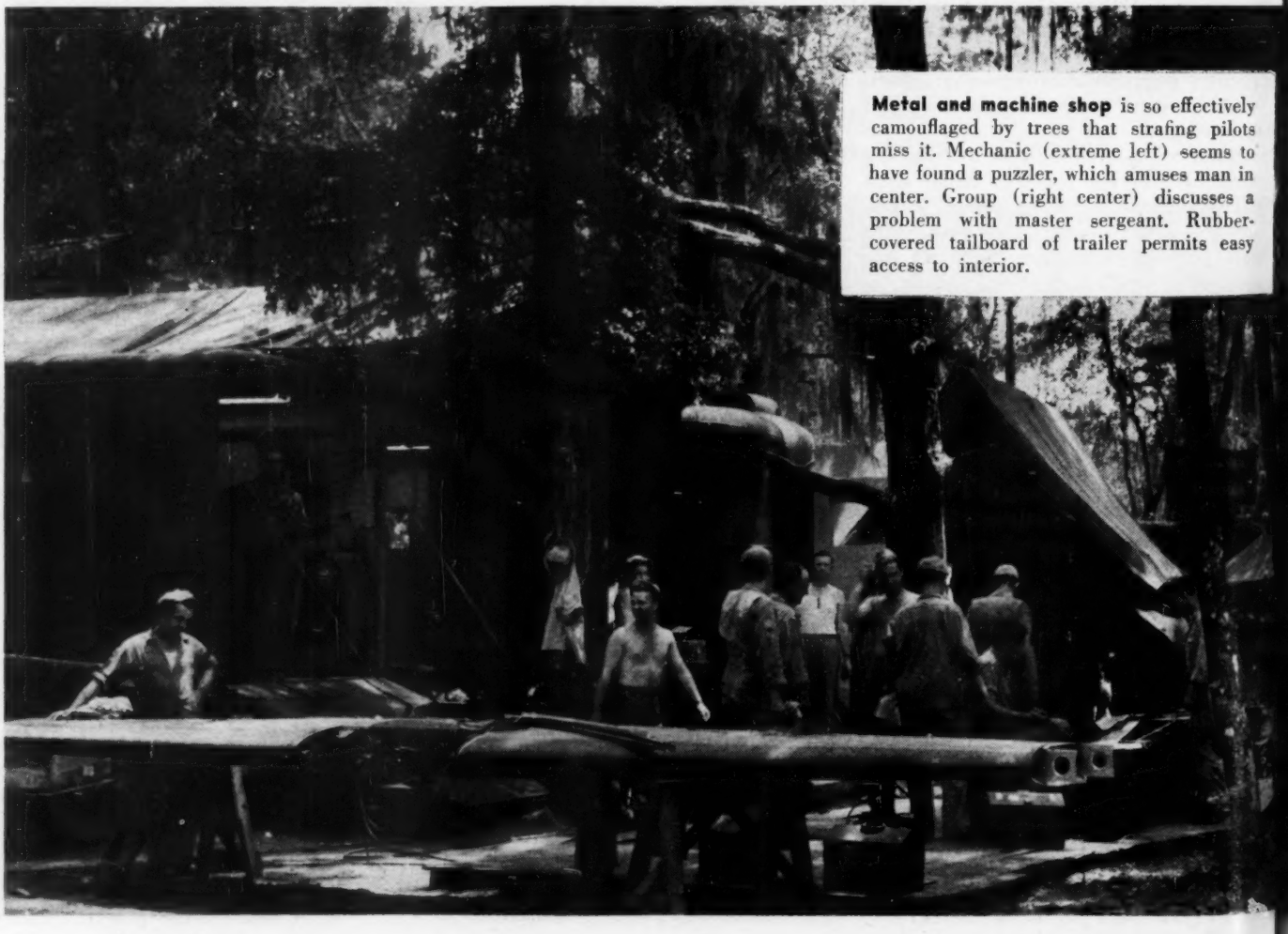
With only natural protection (trees and brush) or improvised camouflage, mechanics complete jobs which formerly called for equipped hangars.

Living in tents and huts and under constant threat of simulated air attacks —as would be the situation overseas— these men develop the resourcefulness which is absolutely necessary for keeping AAF planes in the air.

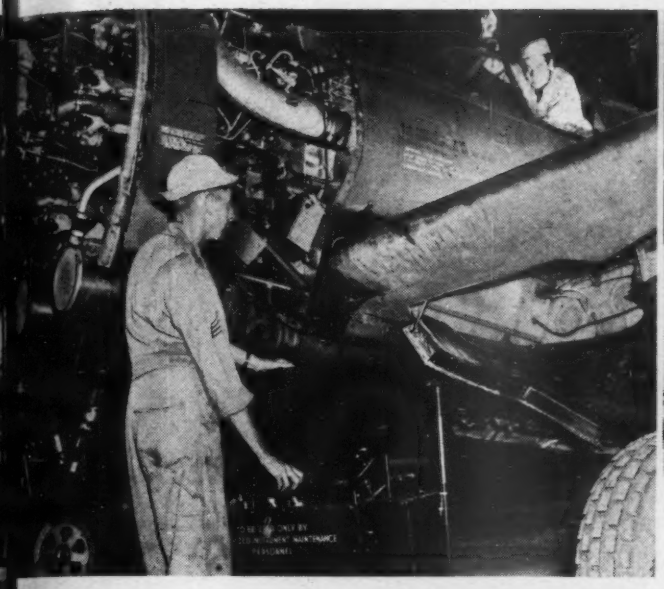
(*Turn page for more photos*)

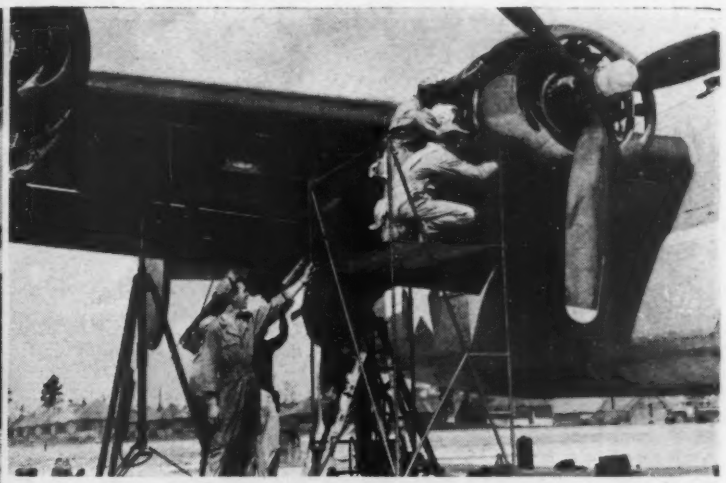
In open spot hidden by trees, crew chief and mechanics do second echelon maintenance on P-47. Protection of prop shaft by cloth shows careful attention to details.

When they need things they make them. Mechanic stands on ladder built from old packing cases. Tools and cans are placed out of danger near wheels.



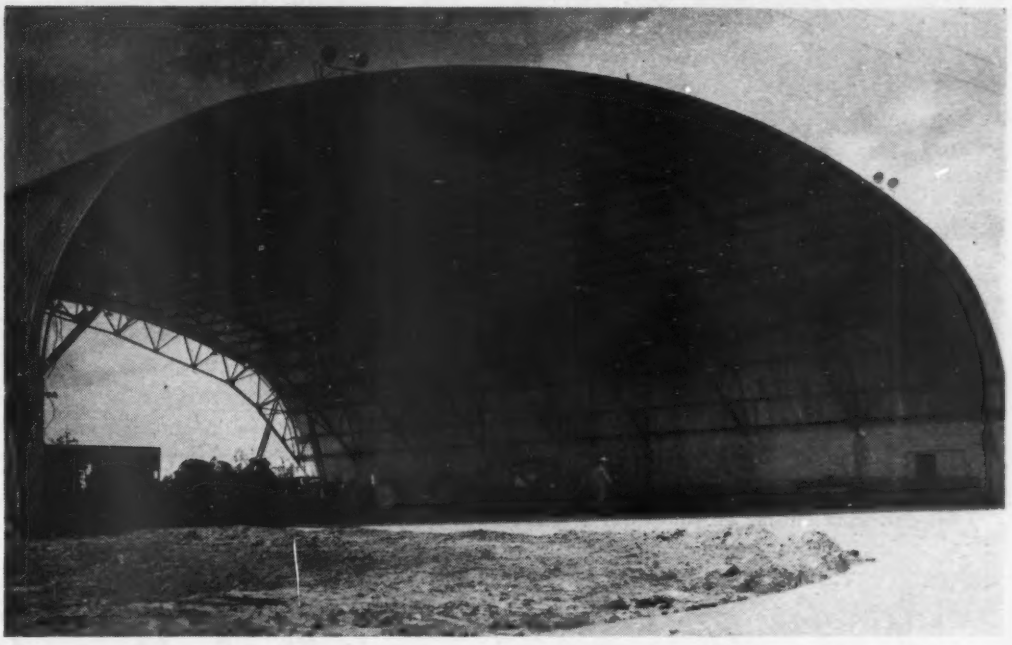
Metal and machine shop is so effectively camouflaged by trees that strafing pilots miss it. Mechanic (extreme left) seems to have found a puzzler, which amuses man in center. Group (right center) discusses a problem with master sergeant. Rubber-covered tailboard of trailer permits easy access to interior.





Finishing a fourth echelon rebuild of *Liberator* bomber. Landing gear and engines are being installed. Even this heavy work is done outdoors under combat conditions.

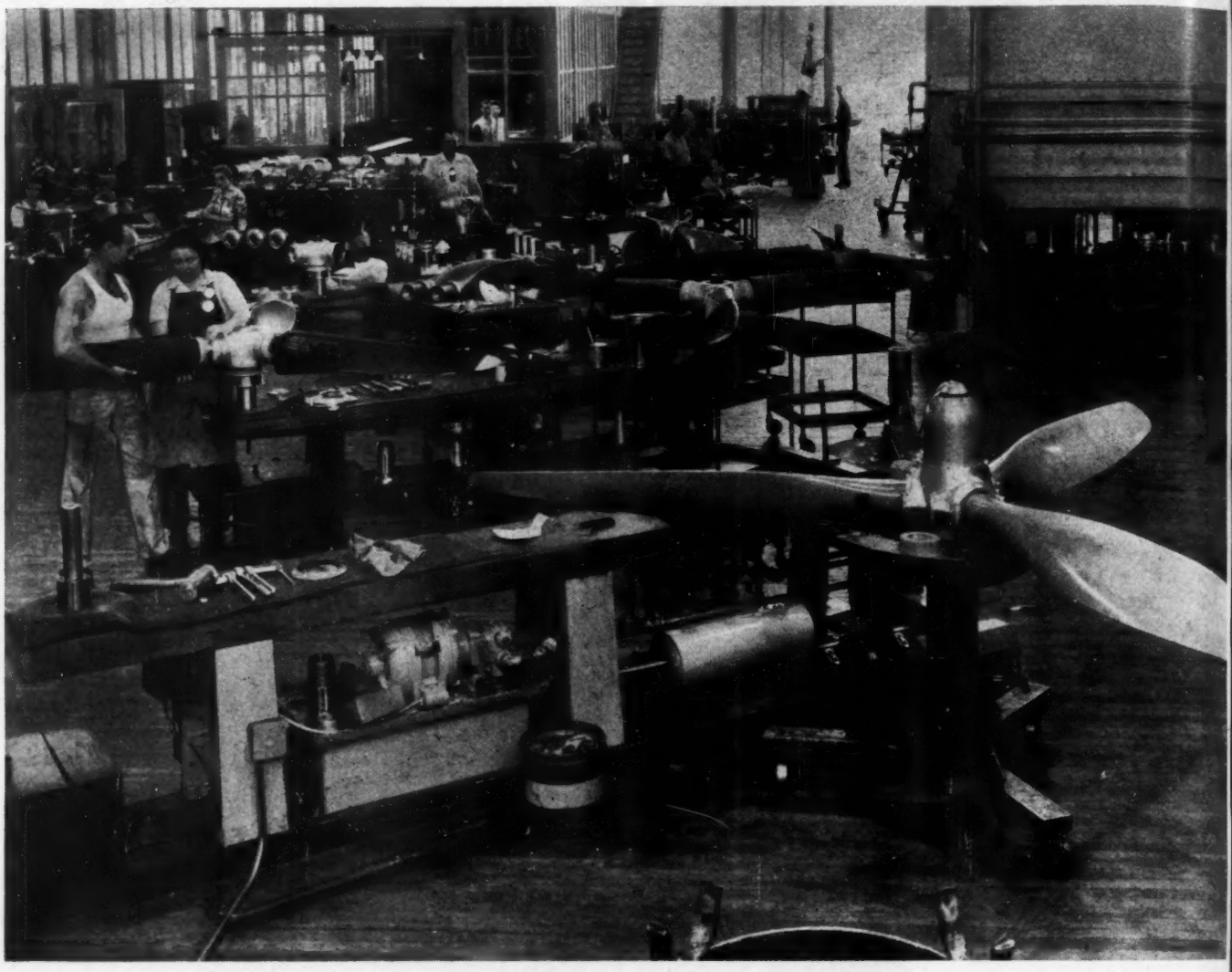
Inspection of electrical equipment on operating airplanes is first and second echelon work. Here crew checks plane instrument board with portable test panel.



AAFSAT sectional hangar. Prefabricated in sections and marked to simplify assembly, these hangars can be rapidly taken down and erected elsewhere. In permanent installations, stone foundations, as shown, may be used.

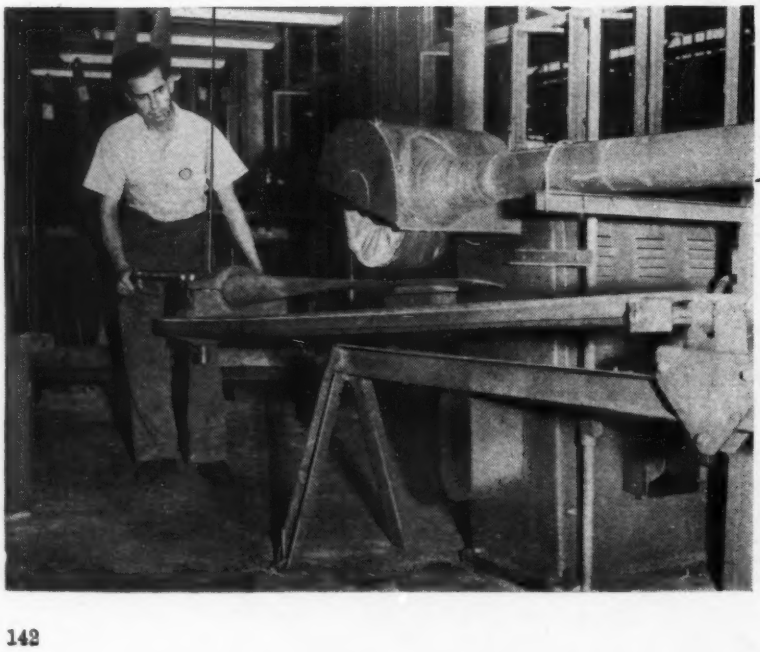
Camouflaged by Spanish moss, canvas roof and board floor make efficient portable welding shop. Gas pipe manifold is nailed on tree as protection against mud in wet weather.

Attack—in this case by AAFSAT fighters—changes mechanics into defenders. Tools are dropped, submachine guns grabbed, and men dive into foxholes, ready for action. In five seconds no live targets will be visible.



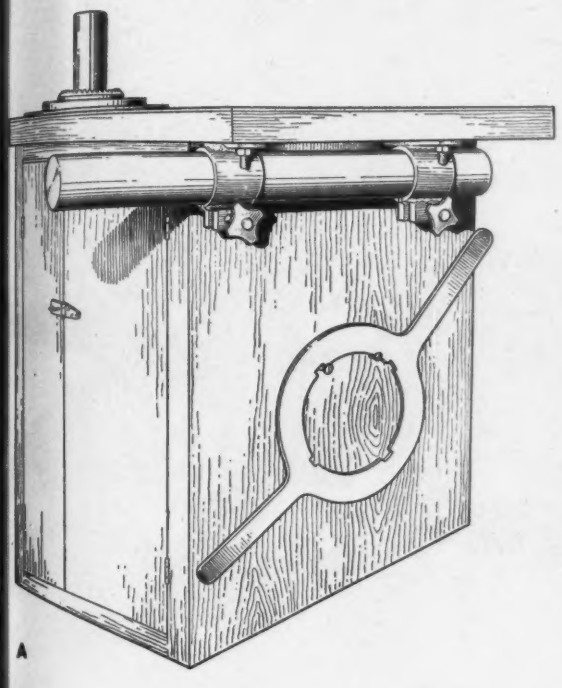
Propeller shop at Jacksonville NAS. To prevent abrasive dust from settling on equipment in main shop, a separate enclosed room, (seen at rear) was set up for buffing operations.

Navy Ingenuity in Propeller Maintenance



A saving of 40 to 50 man-hours daily is the result of efficient arrangement of facilities and creative tool design in the Jacksonville Naval Air Station propeller shop.

Special buffing machine, designed largely by Lt. Murray Aitken, A. & R. officer, is one of principal time savers at Jacksonville. Blade is laid out and clamped to hand-controlled bar. Wire in front of operator runs to weights slung from a pulley to take load off operator. End of bar is fixed to trolley which runs along raised track shown below.



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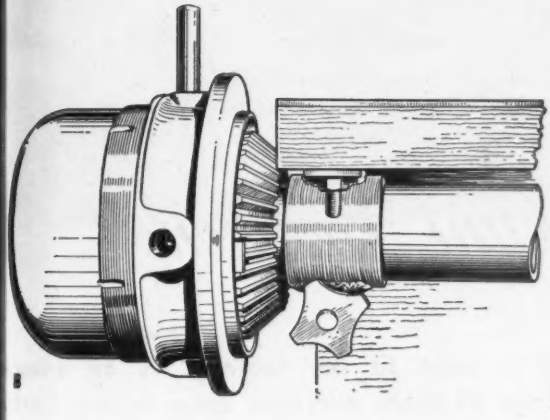

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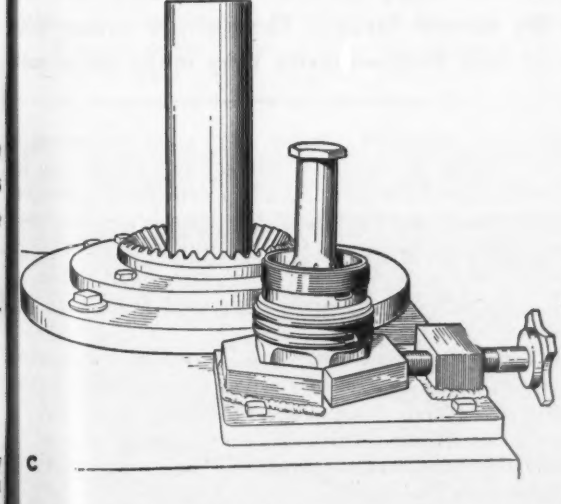
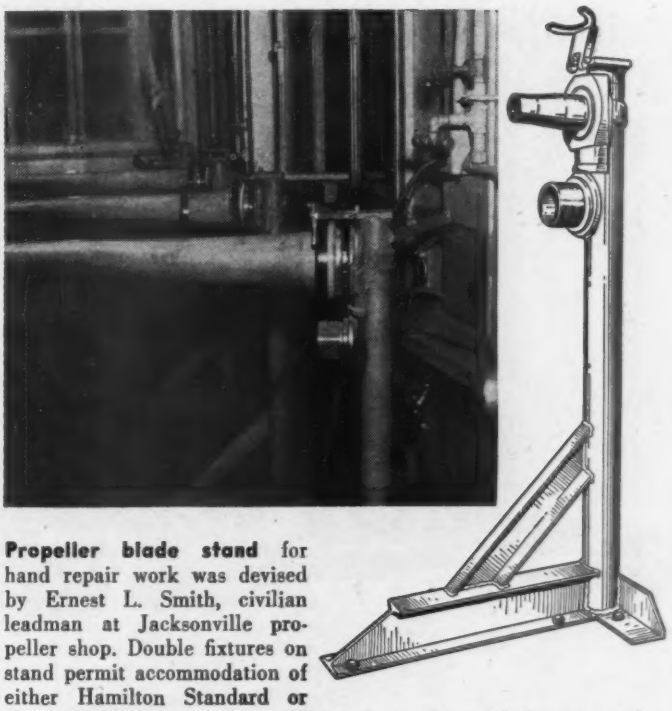
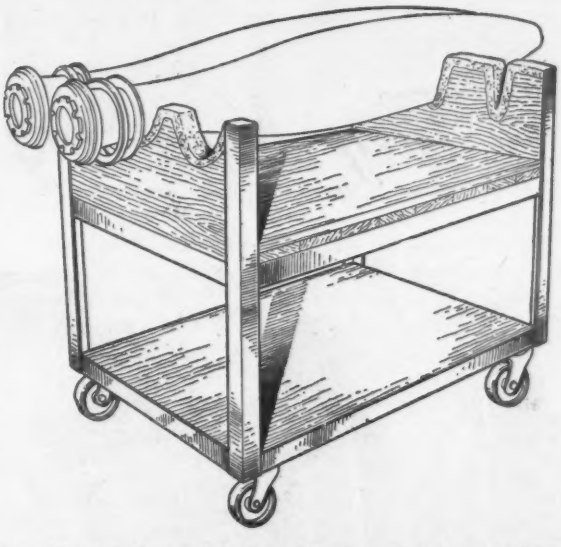


C

Propeller mechanism work stand consists of cabinet for tools and various holding fixtures for dome parts. Sketch *A* shows general arrangement of stand and details of holding fixture for propeller cam and piston assembly. Sketch *B* is close-up of cam and piston assembly mounted on fixture. Sketch *C* shows dome and valve holding fixtures mounted on top of stand.

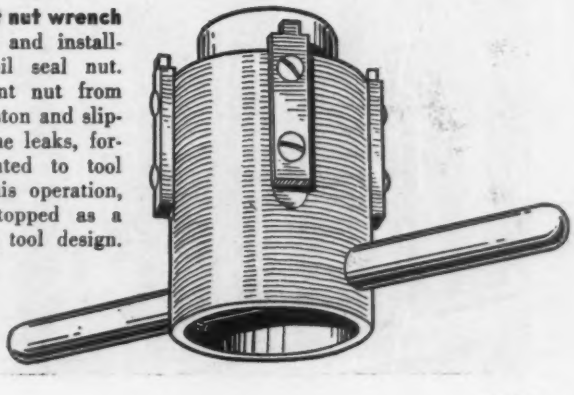


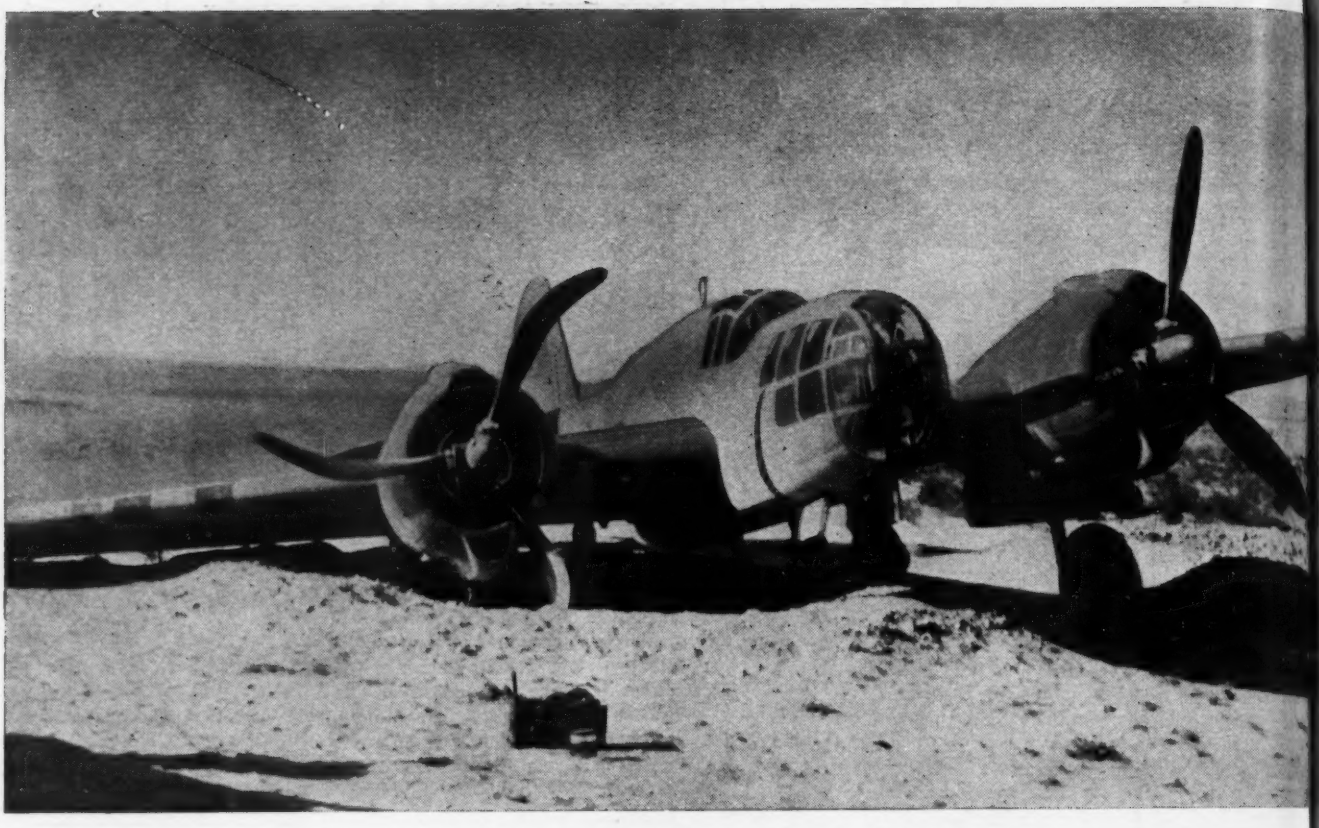
Propeller blade stand for hand repair work was devised by Ernest L. Smith, civilian leadman at Jacksonville propeller shop. Double fixtures on stand permit accommodation of either Hamilton Standard or Curtiss Electric propellers. Photo above shows blades mounted on work stands in buffing room.



Propeller blade cart designed by E. R. Smith at Jacksonville Naval Air Station. Shelves hold dome parts.

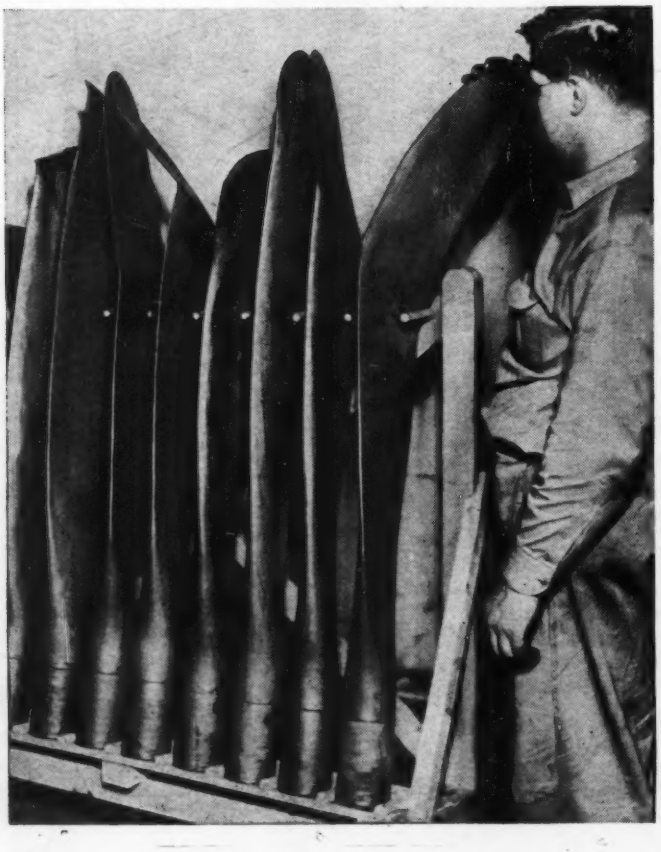
Piston gasket nut wrench for removing and installing piston oil seal nut. Guides prevent nut from cocking in piston and slipping off. Dome leaks, formerly attributed to tool damage in this operation, have been stopped as a result of this tool design.





Bent starboard prop on Martin A-30 cracked up in Western Desert exemplifies propeller repair tasks handled by Curtiss servicemen.

They Never Say "It Can't Be Done"



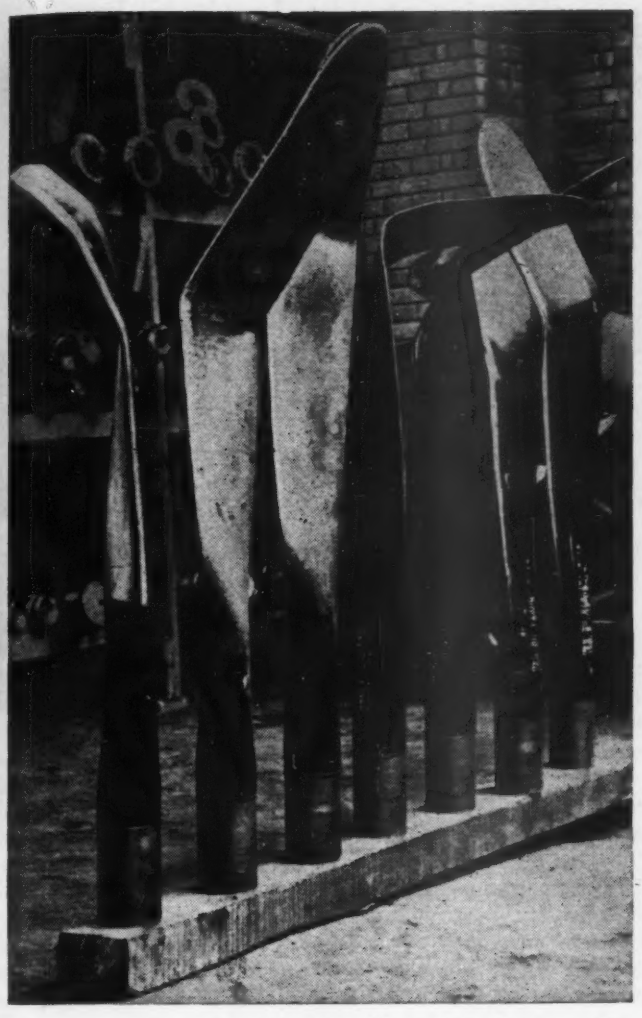
In England, propeller man has plenty of work to do on bent blades.

"Send it back to the factory" is an unkno language at those overseas bases where Curti Wright—and many other—field service men wo with the armed forces. They either make thi work or junk them—mostly they make them wo

THIRTY-FIVE propeller service men must be spread pretty thinly to cover all the fighting fronts. In f many newspapers have more than this number of correspo ents. But even so Curtiss-Wright propellers are be repaired and kept serviceable by just this many mecha instructors, whose work in cannibalizing, overhauling, repairing propellers has won high praise from both A staff officers and flying personnel.

As is the case with all civilian maintenance men overse the work of these 35 men is divided into three phas Repairing damaged equipment; servicing that which usable, whether new or reclaimed; and teaching enlisted and native civilians correct methods of doing this work wh their instructors are absent.

To accomplish this successfully the serviceman must more than merely a skilled mechanic. He has to be capa of obtaining, by diplomacy, the help and materials he wo otherwise have trouble in acquiring; he must without ar ing antagonism, correct faulty methods of working, for



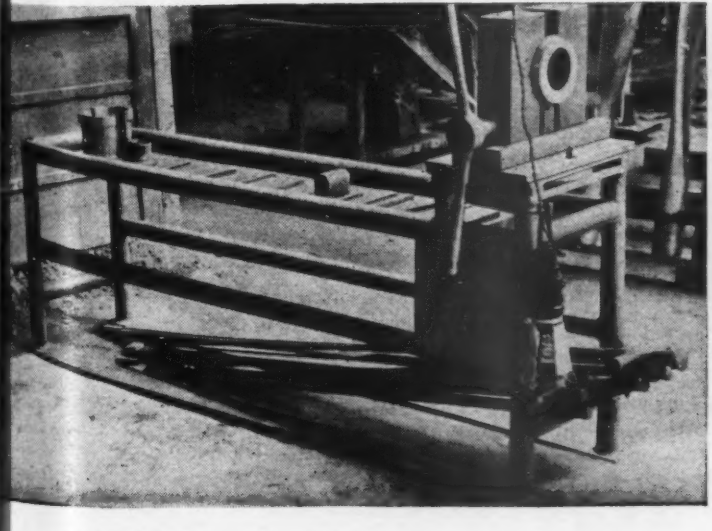
Battle casualties. Though now askew (left) these airscrews will again be serviceable after straightening. Right: Here they are back in shape—ready to return to action.

success depends greatly upon the cooperation of others; and it is essential that he possess the enviable quality of inspiring loyalty and enthusiasm in those with whom he comes in contact. In other words, he must be quite a man.

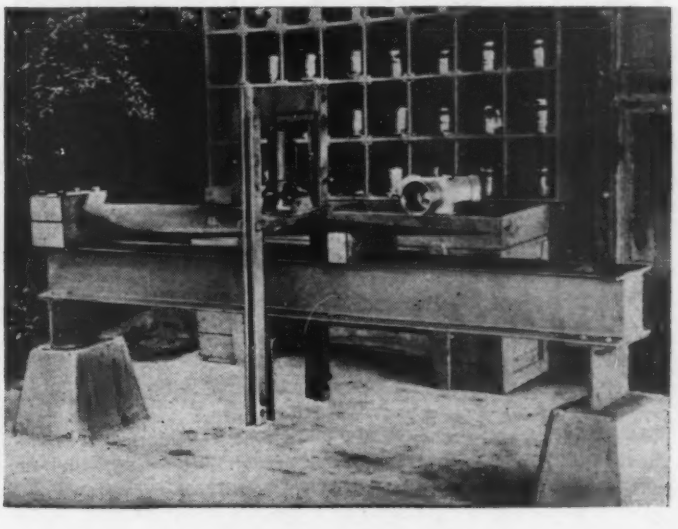
Apart from the purely professional side of his character, the field serviceman requires physical and moral courage in a considerable degree. Take this instance: In Libya, Norman Myers and a companion were thrown from their truck and injured when it was wrecked by a land mine. And on other occasions they had to take hurried shelter when strafed by German planes. Incidentally, these servicemen are quite hard to convince that the *Stuka* is "outmoded." For actual experience with an enemy aircraft is more impressive than cold data discounting its comparative performance.

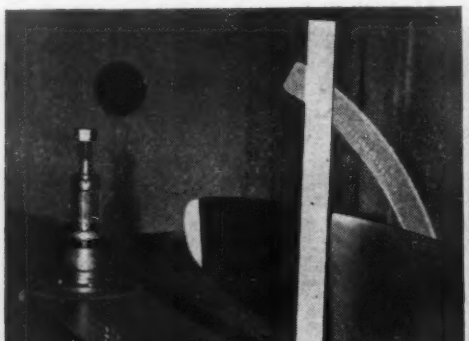
Primary duty of the propeller servicemen, apart from staying alive and in one piece, is to maintain and repair propellers and to instruct ground crews how to "carry on"

A lot of junk—changed into a machine by a lot of brains. Prop blade straightener made from whatever was handy.



This screw jack was put to work straightening blades in Egypt. Note packing-case workbench at rear.





Study in contrasts. Left: PAA propeller repair set-up in Miami. Nice workbench when you can get it. (PAA photo.) Right: Back again in Egypt. Compare protractor (left) with one in last picture. Not so neat—but it does the job.

under combat conditions. To do this, they have followed the air forces into battle in China, Russia, the Aleutians, Great Britain, Italy, the South Pacific, and everywhere else that airplanes are used. In addition to their propeller work they are often called upon to help in repairing the power plant, landing gear, or some other essential equipment of a shot-up plane.

One of the qualities each man must possess is the ability to decide, on the spur of the moment, whether a damaged propeller is worth repairing or is to be relegated to the junk heap. This applies not only to complete assemblies but also to the component parts, which are often more difficult to replace than complete propellers.

Operating through the local air forces commander, the company's representatives set up repair shops and acquaint military personnel with the 'whys and wherefores' of the Curtiss electrically controlled, hollow steel blade propellers.

Constantly faced by apparently insurmountable odds, and often, through changing combat conditions, equipped only with the barest necessities in tools and equipment, these trouble shooters accomplish what has often been considered impossible. Their repair shops frequently consist only of four poles covered with material salvaged from wrecked planes or roofed with grass, native style. The repair equipment, particularly in remote areas, is devised from anything.

As an example Serviceman McRea, working in India, had a lot of propeller blades to straighten. So he rummaged around and collected a miscellaneous lot of I-beams and tubular sections from a wrecked bomber and made a blade straightener which, as he said in his report, "worked like a charm."

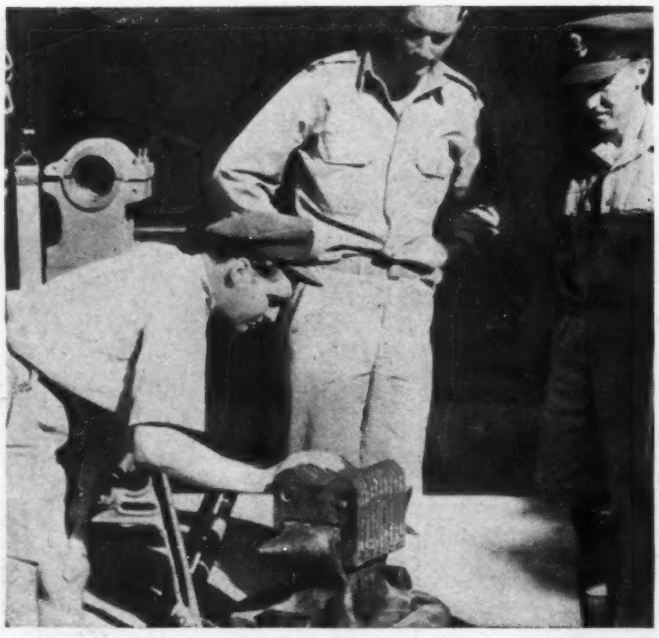
These men have all had considerable experience in this country before going overseas and also have completed the course of instruction in the company's service school, one of the most comprehensive of its kind. Consequently, when they go to foreign lands they are acquainted with the latest improvements in the product they are servicing, hence know exactly what to do under any circumstances.

After arriving abroad, they are kept informed by the company on all changes in design, so that they will be prepared to handle new equipment as soon as it is delivered to the armed forces. In addition, men in the field return home after a year has elapsed to take a refresher course to bring them up to date on the latest equipment or changes.

Since the field servicemen's duty includes the work of keeping the home office informed regarding performance of equipment, they send back reports. Sometimes, these cover rather more than mechanical details, not for lack of technical matter about which to write, but because the work and personal experiences are so completely interwoven that they cannot be separated. George J. Wallis, somewhere in India or thereabouts, opened his report with the words: "No, I haven't been captured—yet." Another man explained that his work was becoming harder "because it is being done under most difficult conditions." He explained: "Practically all the work is done at night because alerts and weather keep us ducking. Then, at night we are kept on our toes by hungry panthers snooping round our tents and workshop."

Kenneth Stryker, who followed the U. S. Forces into Sicily, wrote that "the men here are constantly on the move. We never know, from day to day, where we will be next."

Experiencing the rigors of war and climate, these men whose names probably never will get into dispatches or citations, are doing more than most to bring the war to a close —by keeping the planes of the AAF in the best possible mechanical condition.



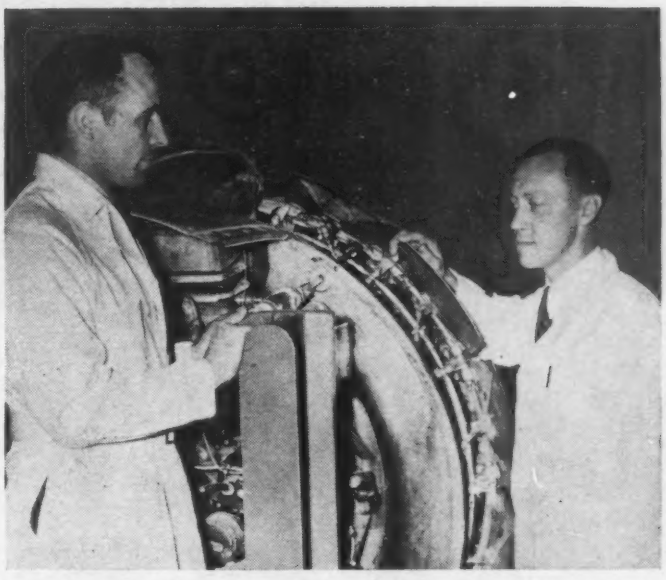
RAF officer (right) marvels at highly practical equipment which Servicemen Powell (left) and McRea (center) have conjured from scrap metal to speed repair work at Egyptian base.

Continental Improves Cowl Flaps

EDWIN L. DURHAM AND EARL G. PETERS of Continental Air Lines' repair base at Denver perfected alterations to the engine cowl flaps of the company's Lockheed *Lodestars*. This system differs from the original operation of the flaps, which was by an electric motor through a flexible drive shaft and gear box. Under favorable conditions, the motor and shaft were operating at peak capacity. But at any other time, running for more than a few hours without trouble was impossible.

The new hydraulic system provides the necessary power to actuate the flaps under all conditions. The hydraulic control valve in this system enables the pilot to trail the flaps, which is ideal in certain cases of airspeed versus engine head temperatures.

Another source of trouble was the tendency to form flats on the point where the flap-actuating tube was supported by two small aluminum rollers. As these rollers were not preloaded, the vibration soon produced flat spots on their surfaces, after which operation was difficult, if not impossible. By using spring-loaded fiber blocks in place of one of the rollers, this difficulty has been eliminated and with it the noise caused by the excessive clearance.



The men who did the job—Durham (left) and Peters (right).

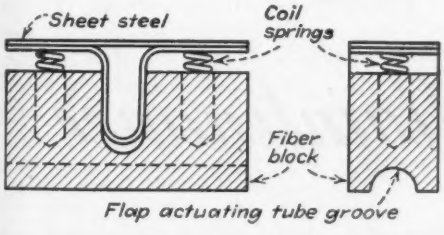
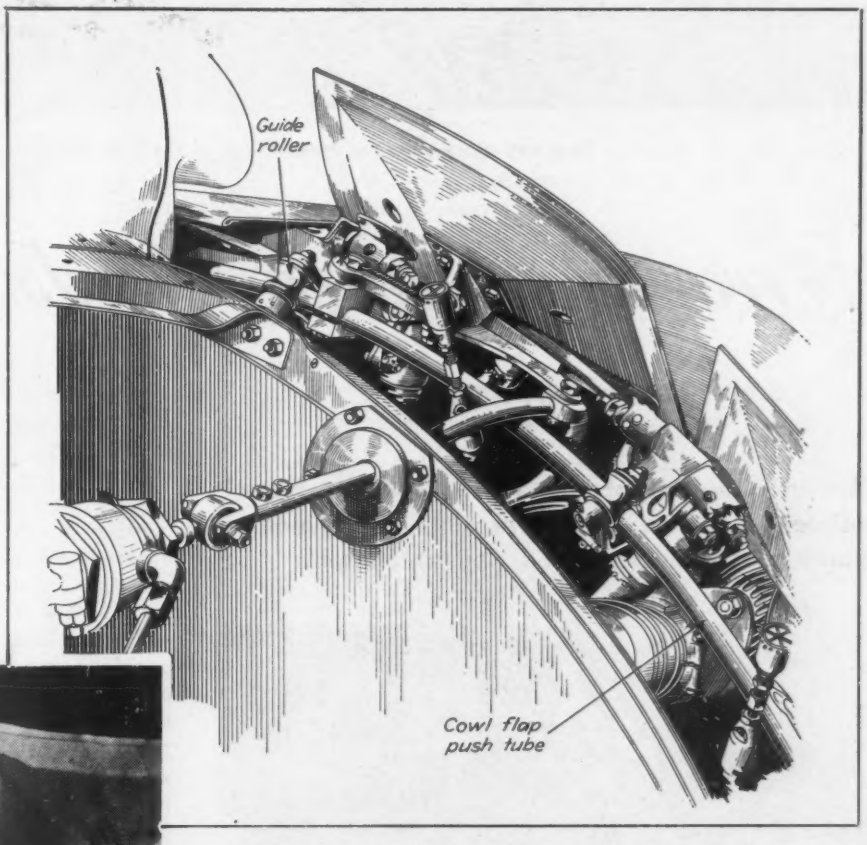
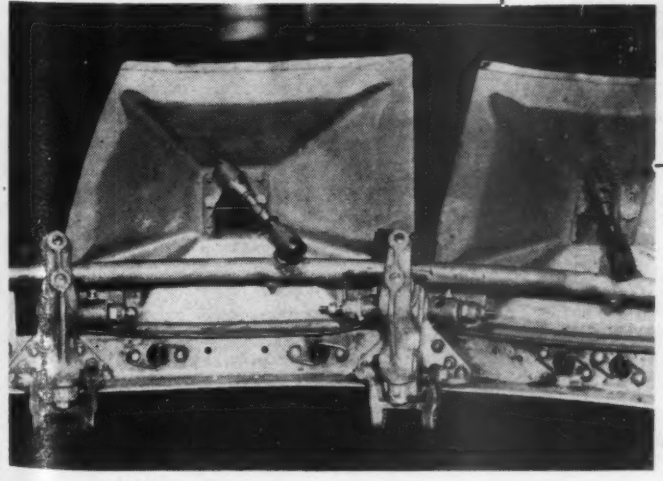


Diagram of fiber block which replaced roller in later models.



Cowl flap mechanism fitted with hydraulic cylinder.



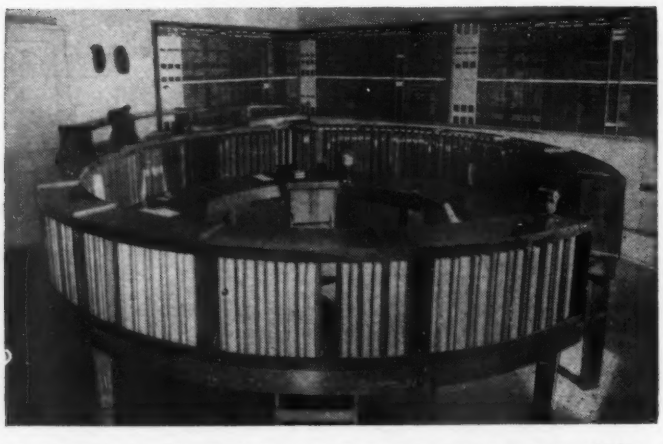
Spring-mounted fiber block which stopped vibration, preventing wear on flap-actuating tube.

Tool and store room on ground floor of shack in center floor of RCAF hangar.

Crew Competition Speeds Maintenance

By **JAMES MONTAGNES,**
"Aviation's" Canadian Correspondent

"Secret weapon" of the RCAF is fast, efficient maintenance, with smallest possible percentage of planes grounded for the least possible time.



Circular log-book desk. Girls sit in center and data is handed in from outside.

EFFICIENT MAINTENANCE, sparked by the incentive of time off for fast-working crews, is keeping close to 87 percent of all training and combat aircraft in the air at Royal Canadian Air Force stations throughout Canada. Weekly reports from all stations in Canada enables RCAF headquarters at Ottawa to keep an accurate check on the number of serviceable aircraft and allows for the sending of technical investigators to stations dropping below the high percentage set by other stations.

The features of this maintenance method—features which go a long way in keeping so many RCAF aircraft serviceable at all times—were largely developed at Uplands Station, Ottawa, under Wing Comdr. S. A. Greene of the Directorate of Repair & Maintenance. As each new idea worked out successfully at Uplands it was included in the RCAF maintenance set-up and standardized at all stations.

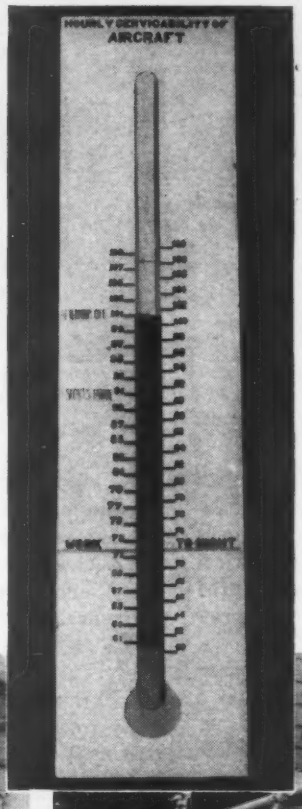
One of the first moves towards efficiency was the location of all stores and control operations in the center of the hangar. At each maintenance depot there is now a two-story shack centered in the hangar, with stores and tool departments on the ground floor, and records and controls upstairs. On this second floor there is also a public address system with which any maintenance crew member can be quickly summoned, saving much running around.

Here also is the maintenance record of all aircraft on the station. Aircraft log books being bulky and heavy, it was always a big chore to take down the books from wall racks

CAF maintenance hangar with control and stores ack in center. Aircraft routing is counter-clock-ise, starting from right.

o make the necessary numerous entries each ay the aircraft was in for repairs. To over-ome this, a circular desk was devised with pecial compartments where each log book tands upright. Four girls of the Women's Division, RCAF, are seated inside the circu-ar desk. Each one simply reaches for the equired book in her section of the desk, ulls it out, lays it flat on the table directly in ront of her chair, makes the necessary entries, nd files the book back in its slot. The desk makes for efficient and quick handling of all necessary bookkeeping entries. It is one of the many "gadgets" now standardized in the maintenance shops.

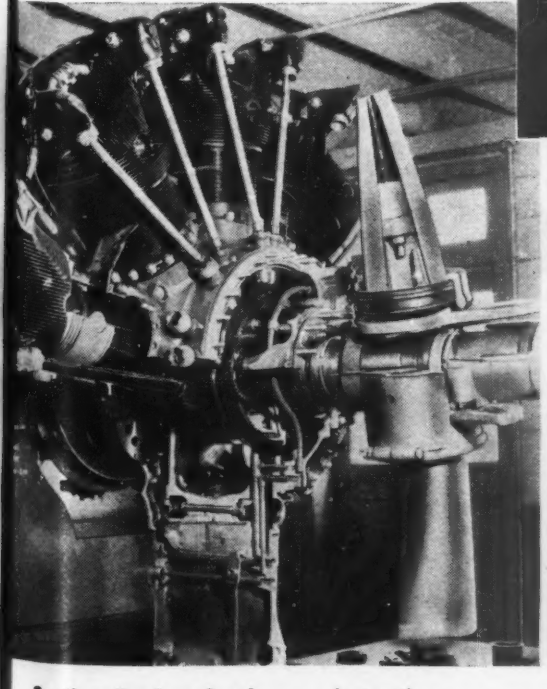
Aircraft arriving for repair and overhaul ome in the right hand section of the hangar nd are routed counter-clockwise, at all times



Red marker on this "thermometer" is moved hourly to show number of aircraft to be serviced before time off is given to crews.

being within view of the maintenance control room. When aircraft come into the hangar, a dummy clock high up in the hangar is pushed 3½ hr. ahead, scheduling the time when the "next move of the aircraft" is made and thus reminding the maintenance crews that minor checks are to be finished within that period. As stated, there is an incentive for fast work on the job—the reward of time off.

A big "thermometer" showing hourly serviceability of all aircraft is hung at one end of the hangar so that it can be readily seen by all workers. On it, the total number of aircraft at a station are indicated in degrees. At a height comparable to the freezing point, the thermometer is marked, "Work Tonight", for if the number of serviceable aircraft does



Sectionalized engine for crew instruction.

Ladder on fuel-truck front saves wing wear from feet of fueling crew.

Simple extinguisher truck speeds fire fighting.

Dope-spray truck carries two five-gallon supply cans.

not come up to this mark, all maintenance men must work that evening.

High up the thermometer a line reads, "Sports Parade." When crew performance reaches this point, a sports afternoon is the reward of the crews. Moreover, an "Afternoon Off" is tagged near the top of the device, and when serviceability of aircraft soars to this mark, the crews are granted time off. The red canvas strip representing the "mercury" is adjusted hourly.

The maintenance system at these RCAF stations is based on the principle that manpower should be concentrated on a few planes to get them into service rapidly. As many men as possible (without getting into each other's way) are put on each aircraft, thus cutting down the work time required. Under this plan fewer aircraft are in the unserviceable category at any one time.

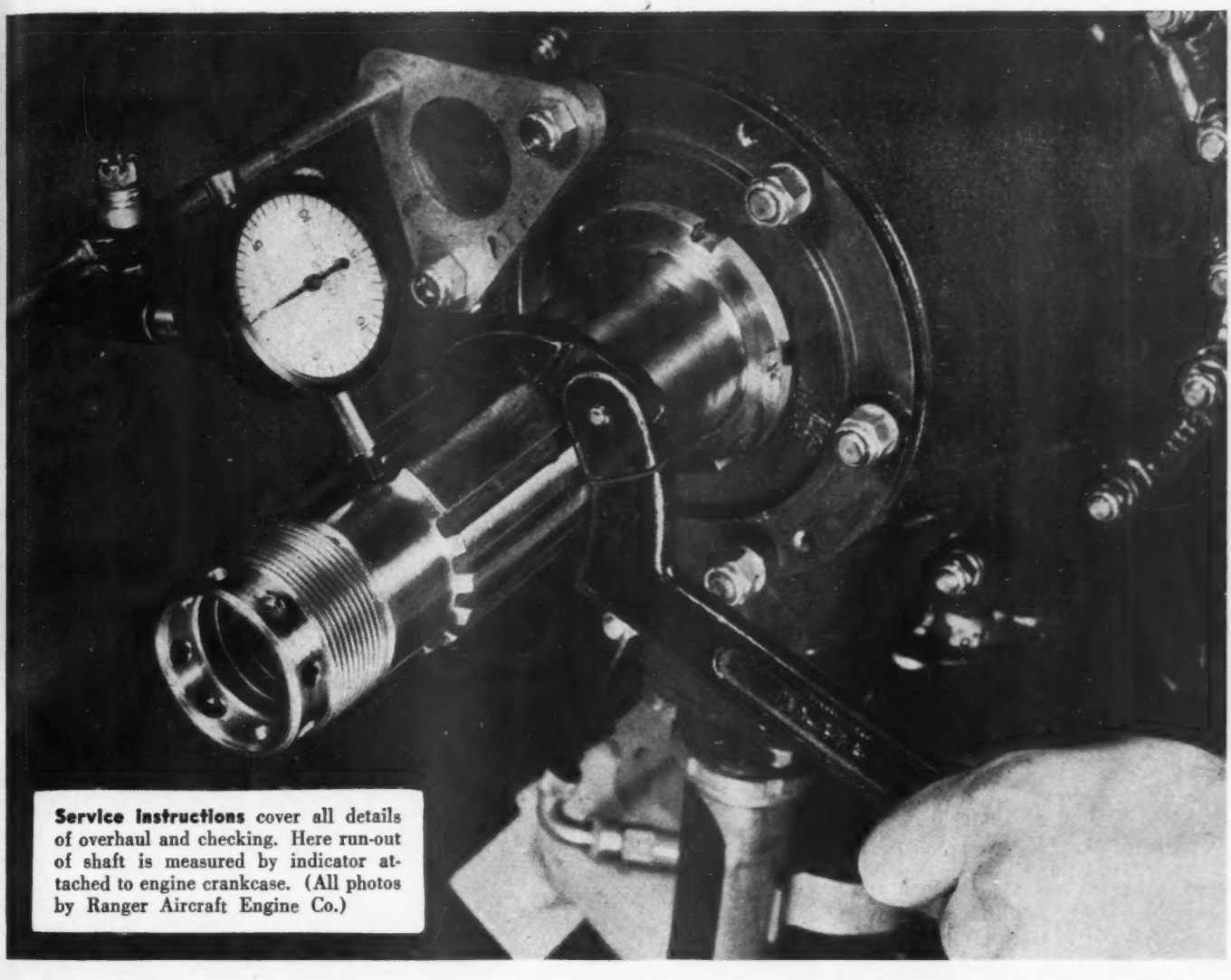
Each job is rated for the maximum time it should take, and each mechanic notes how long it took him. When he is finished he has no reason to appear to be working. Instead, he lists his name on the control board as "not working" and awaits another assignment. Guesswork as to whether or not a man is working has been eliminated by this plan.

Each crew consists of a corporal and three mechanics one of whom in many cases is just out of training school. The corporal works closely with his men, checking their work and signing for it. In charge of three such crews is a sergeant, who re-checks the signed work and then signs for it. Final check is given by a flight-sergeant, who signs for the overhauled or repaired aircraft before turning it over to flying personnel for further checking.

(*Turn to page* 311)

Labor saving truck for transferring fuel.

Bottom of fuel-drum truck, showing ground chain.



Service instructions cover all details of overhaul and checking. Here run-out of shaft is measured by indicator attached to engine crankcase. (All photos by Ranger Aircraft Engine Co.)

Ranger Service From Policy to Performance

By PAUL E. BATTILANA, *Service Manager, Ranger Aircraft Engine Div., Fairchild Engine & Airplane Co.*

Field service on aircraft power plants is more complicated than most engine users realize. Company cooperation with the customer is primary. Revealed here are the whys and hows of that cooperation.

THE BEST ENGINES built today require special handling, for they are complex mechanisms. Further, at the present time these aircraft engines are being maintained and serviced by military and civilian personnel who, for the most part, are new to the industry and at best have only a recently acquired knowledge of such high output power plants and their proper care.

But the fact that there is enough "know how" instilled in the minds of the country's engine mechanics is proven by the excellent performance of American-built engines in all climates and in all corners of the earth.

Such performance would not be possible without proper servicing. And in this connection, it is evident that the service departments of American manufacturers, together with those divisions of the armed forces which perform a similar function, are responsible for the success of this vast undertaking.

Any customer procuring an aircraft engine, whether he represents a military or commercial organization or is an individual buyer, must necessarily look to the manufacturer for operating and maintenance instructions, overhaul information, and special tools, plus answers to all the questions which, inevitably, present themselves if he is to obtain the full value of his investment. These are the problems of a service division, whose activity to see that the

Another example of servicing instructions—lining up cylinders by means of special gage.

Gaging of end play of connecting rod on crank is simplified by service instructions.

owner is getting full value offers a yardstick of the manufacturer's integrity. Here, then, is the hidden value purchased as part of the engine.

There are no hard and fast rules, as is the case in the terms of a power plant guarantee, but the resultant customer satisfaction is a sound basis for future sales. Looking after the customers' interests and ascertaining that the product is properly understood and cared for has always been the aim of Ranger's service division.

The aforementioned, though simply stated, indicates that there is a lot more to service work than meets the eye. And this is largely true. But in this company's case, the burden is lightened by having an easily maintained, straightforward designed engine requiring a minimum of attention. This is offset to some extent by the arrangement and type of cylinders—in-line, inverted, and air-cooled. These are features which, although advantageous, require some education of the owner to convince him that there is actually nothing about it which requires any special handling.

For efficiency, the service division has found it necessary to break down its work into six departments, each of which is responsible for a separate function. Operations, however, are closely interrelated, and there is frequent conferring on the problems. Thus, the departments do not become autonomous. They are, in fact, responsible to the service management on an equal basis, and the head of each is an expert in his own line.

The publications department prepares

Removing cylinders without damaging pistons is another example of correct service methods given by a service manual.

ll instructional and technical matter ssued to the field. Instruction books, erformance data, catalogs, and overhaul manuals must be prepared on each ew model engine before the product eaches the customer. In the case of ilitary engines, all data must meet the equirements set forth by the service hich will operate the equipment.

More latitude is allowed in the preparation of data for commercial consumption, for it is felt that such publications miss the goal when they are lat and uninteresting. When such information is too formal and lacking in ppeal, the reader soon finds it "bogs im down," and he decides either to inish it later or merely to use it as a eference. With a bit of dressing up nd a good job of illustrating, cold hard acts may be read much easier. It is nteresting to note that 2,000 photoraphs were taken to illustrate the text f a recently published overhaul manal, all this in addition to the art work equired to dress up the pages and larify the more complex matters.

The service tool department is called pon to design and standardize all tools, its, special jigs, and fixtures for maintenance and overhaul work. In the vent of improvements which may be ncorporated in engines in the field, his department takes an active part in resentation of the modification to inure that the work may be accomplished ith a minimum outlay of special quipment.

Despite its ominous name, the failed-parts department does basic service division work. All complaints and information received from customers, either directly or through the far reaching activity of the field service department, are carefully evaluated and recorded, for the principal return on the manufacturer's investment in service personnel is the field experience gained. Failures are analyzed for underlying causes, and the condensed data is forwarded to the engineering division for consolidation into improvements in new or existing models.

Claims for credit on the return of damaged parts are studied and the recommendations for adjustment are forwarded to the accounting division. This work requires careful consideration inasmuch as equitable settlements are absolutely necessary and the extent of responsibility of the manufacturer, in cases where faulty operation may be a factor, is frequently quite obscure.

The service school has been set up to instruct both company and military personnel in the care and operation of our products. Here, the course of instruction is condensed but thorough. Students attend lectures and classes in which instructors make liberal use of cinematics, charts, actual engines, and accessories. Courses in assembly, disassembly, maintenance, and trouble-shooting follow theory and fundamentals, and the program, in the case of field service trainees, is wound up with actual work in the service division's overhaul shop.

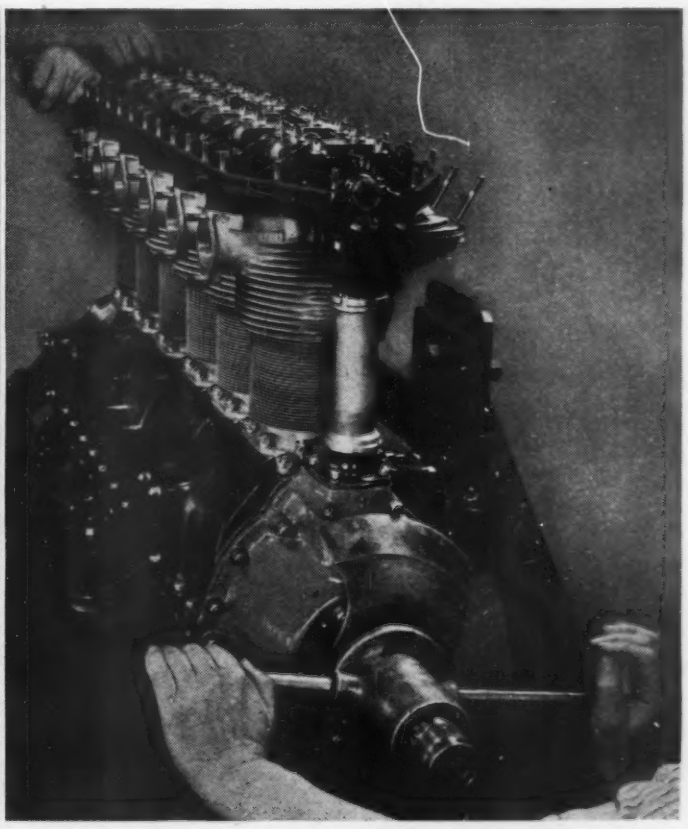
Instruction given in the service school should not be construed as a complete technical education, since it is designed as a conditioning operation for personnel with a strong technical background.

The service overhaul shop is housed in its own modern hangar, adjacent to the main plant. Its ramp and taxiway make it accessible to aircraft visiting the factory for engine repairs or adjustments. This department does all factory overhaul work and supplements its own machine shop by drawing on the factory for special operations involving use of heavy machinery and test facilities. In fact, much overhaul subassembly reconditioning is performed on the machines which originally manufactured the parts. In this way, it is possible to recondition an engine and return it to service with the knowledge that it will perform as new equipment. Furthermore, at overhaul all applicable modifications and improvements are automatically incorporated.

The above departments are more or less obscure behind the factory wall, hence the layman knows little of their activities. On the other hand, the field service department, with its representatives in many countries and climates, is perhaps uppermost in a person's mind when he thinks of the service division's responsibilities. This department, of necessity, has in its employ a relatively

(*Turn to page* 348)

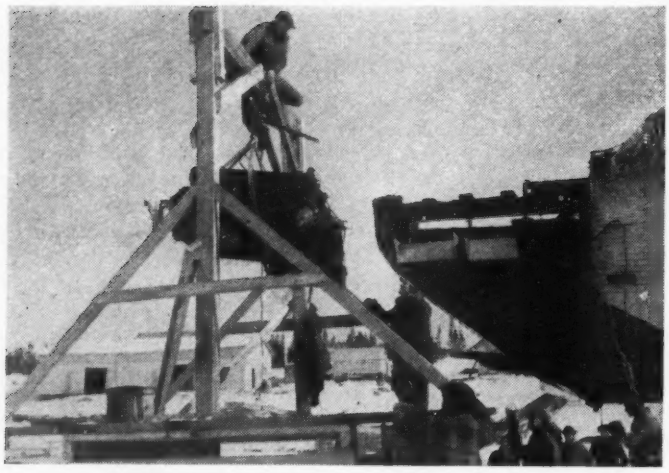
Typical illustration in service manual giving instructions for replacing bushing.



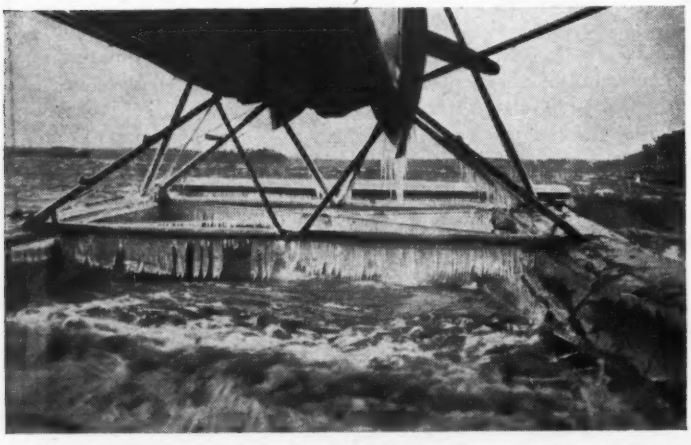
This Ranger service manual illustration depicts method of timing engine.

Airline Maintenance In

Trying conditions are every day routine with Western Canada's pioneering lines, which frequently must handle maintenance and repairs "right out under the big shed." This story details the practical 4-period inspection system which keeps CPA ships in tune.



Wearing mackinaws and ankle deep in snow, CPA mechanics install a 920 hp. Rolls Royce *Buzzard* in a Junkers, which can carry a 3-ton load.



Pontoons present a de-icing problem rarely considered by the engineers. This is routine trouble every spring and fall.

OPERATING virtually all north-south air routes in Canada over a varied terrain with a great many types of aircraft, Canadian Pacific Air Lines has maintenance problems which differ greatly from those of most commercial transport operators.

Operations range from mainline routes, such as the Vancouver-Whitehorse, Yukon, run with Lockheeds to "bush" runs into northern Ontario with Fairchild or Junkers aircraft. Maintenance and overhaul routines depend in a large measure on facilities available, especially in winter months. Further complication is the fact that these aircraft use pontoons in summer and skis in winter, except on the inter-city prairie runs and on the Yukon route where new airfields are available.

On its mainline runs, CPA is developing a system of regular inspections. It is also endeavoring to establish this system on bush lines, but the variety of aircraft used is causing some difficulties. On the mainline routes there is an en route flight check, with no work done on the engines unless the pilot reports something in need of attention. This No. 1 check includes an engine ground test, inspection of gasoline tanks for leaks, refilling of anti-icer tanks, inspection of propeller blades, visual inspection of the cowling, checking of the oxygen supply, cleaning of the lavatory facilities, and if there is time, cleaning of the windows and cabin.

The No. 2 check—every 8 to 12 hr. of flying time—consists of a thorough engine, propeller, and aircraft inspection, as well as an engine ground test. The No. 3 check is made after 50 hr., but if conditions necessitate, it may be postponed to 60 hr. (but no longer). This No. 3 check is more thorough than the No. 2.

Finally, there is the No. 4 check after 200 hr. (but which may be postponed to 210 hr.). This requires a very careful power plant inspection, with 26 items on the list, including cowling, checking of feathering operation of propellers with sump plugs removed, replacing spark plugs, inspection of magneto contact breakers, all accessories, exhaust stack, and similar details. There are also 70 items on the aircraft inspection list for this check, including the removal and inspection of wheels and brakes, emergency exit, opening of inspection doors and inspection of controls, checking of the hydraulic system, and tightness of the airframe, as well as the various instrument, radio, electrical, and oxygen installations.

Pre-flight inspection on the ice is part of the day's work. Portable work platforms are usually oil drums.

"In the Bush"

CPA has standardized airplane and engine report sheets for these four checks on its mainline runs using Lockheed equipment, and it hopes to do the same for its other equipment, which includes Barkley-Grow, Beechcraft, Bellanca, Boeing, Fairchild, Junkers, Curtiss, American, Travel Air, Noorduyn, deHavilland, Stinson, and Waco planes—various models, some 77 aircraft in all.

Similarly the company has a large variety of engines, including Pratt & Whitney, Wright, Jacobs, Lycoming, Rolls Royce, and deHavilland—a total of 217. This plainly shows the difficulties involved in the company's standardizing of maintenance procedure on lines operating throughout northern Canada, from the Atlantic to the Pacific, and to points north of the Arctic Circle.

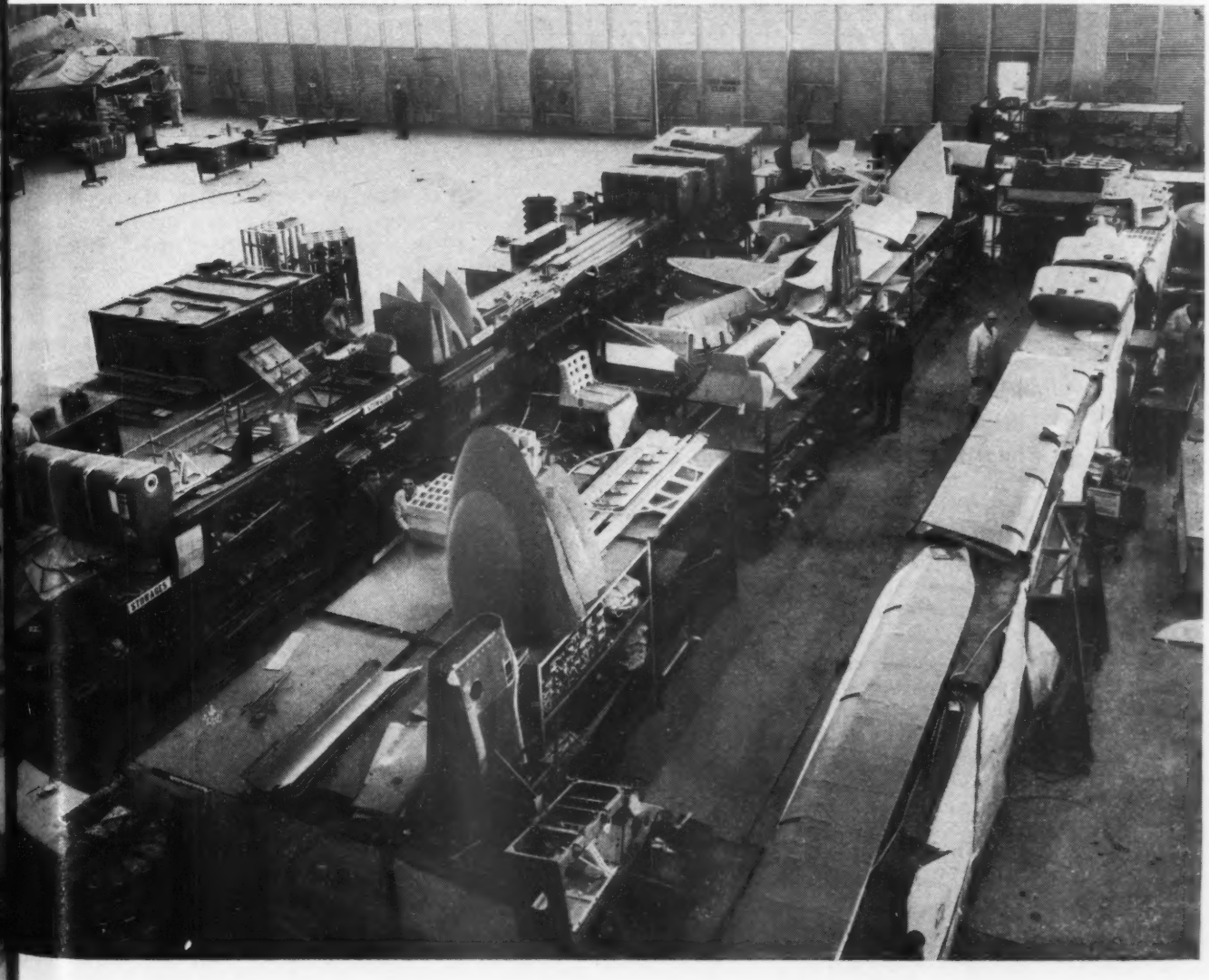
Typical of these bush maintenance operations is that of the CPA Central Division headquartered at Winnipeg, which operates throughout northern Manitoba, northwestern Ontario, and northeastern Saskatchewan. Four separate airlines operated these runs before CPA consolidated them. These facilities still carry the marks of the former owners; they were only taken over in 1942.

The chief maintenance engineer of this division periodically visits the various bases and reports to the CPA superintendent of maintenance at Winnipeg. Forms developed for use in this district include a general maintenance report listing work done on each aircraft and engine, an acceptance release from the pilot taking over from the test or ferrying pilot, an engine failure report, and an engine overhaul report. Each aircraft carries a complaint book to give the operations and maintenance personnel details of what work is necessary.

Inspections are made daily before flight, from 25 to 30 hr. of flying time, again after 50 to 60 hr., and between 180 to 200 hr. Oil changes must be made every 70–80 hr., except on oil diluted engine installations, where it is only necessary to add fresh oil to keep the oil level in the tank normal. Spark plug changes take place every 50–60 hr. Oil strainers must be removed at least once every 25 hr. A new or an overhauled engine always has a major check after 20–30 hr. of operation. The propeller, after servicing, is checked for tightness on completion of first flight.

(*Turn to page* 315)

Vancouver, the West Coast base, has complete supplies and up-to-date shops and hangars.



Airplane tire deteriorated by direct sunlight.

Disastrous tire wear can be avoided. By following these methods of tire inspection and maintenance, you'll quickly put the finger on rough usage, improper storage, oil and heat damage, and "unbalance" repairing*

ANALYSIS OF DAMAGE to tires shows that in a large number of cases their useful life depends not so much on the number of landings made as on the care given them by the ground crew and the handling of the plane by the pilot when taxiing.

Many tires lose a large percentage of their strength and wear resisting qualities because of improper storage. Oil, heat, and bright sunlight can be harder on your rubber than heavy operational use of it. Tires should be stored in their original wrappings. They should not, however, be stacked one above the other, since this method, though saving space, causes the lower tires to become badly distorted through sustaining an inordinate weight. Balance is of paramount importance in airplane tires, and any change of shape may "set", causing the tire to assume the same position when installed and resulting in the same portion of the tread always making the initial contact with the ground. This continual wear on one place will quickly cut down the life of the tir though most of its surface will still be in good condition.

Tubes which have been removed from their cartons w keep best when slightly inflated and placed inside the casings. Dirt should be excluded by keeping the valve c on the tube at all times.

Before mounting, wheels should be examined for bur which might damage the tires or tubes. Balance marks tubes should be carefully located at the red dot on the casi In event there is no balance mark on the tube, the val should be lined up with the red dot. Unbalance in tir in addition to causing wear, also results in severe vibrati when landing and taking off.

No lubricants should be used between the tire and wh since this practice tends to cause slippage between the parts. A small amount of tire talc may be used to preve the tube from sticking to the casing. Because there is tendency to wrinkling in these large tubes, they should

* Photos courtesy B. F. Goodrich Co., Akron.

Bead damage caused by improper use of tools.

Center wear caused by over-inflation.

Edge wear caused by under-inflation.

inflated to seat the tire beads properly, then completely deflated and reinflated to the correct pressure. This is necessary to remove wrinkles and prevent pinching of the tube. In dismounting tubes, always remove the valve cap and core to make sure no pressure remains. Obviously, bruised or burred tools should never be used, either for dismounting or for replacing tires. Hence, mechanics should be warned against "tossing the tools around."

Since wear is governed to a large extent by the air pressure, correct pressure should be checked on a regular schedule, preferably two or three times a week. Newly mounted tires should be checked daily for several days, for frequently air is trapped between the tube and casing, causing a false reading on the gage. As this air slowly seeps out, the tube expands, causing a considerable drop in pressure. Keeping the valve cap screwed down finger-tight at all times will prevent leakage from the tube at this point, even if the valve core is defective.

Cuts in the sidewalls or treads, exposing the fabric, are sufficient cause for immediately removing a tire. Minor scratches do not affect the safety of the tire and may be left for attention when the tire is removed at the regular time. Tires showing any bulging or unusual distortion should be taken from service at once.

Normal inspection routing should include removal of tires after 150 to 175 normal landings. The outside of the casing should be carefully inspected for damage and the interior checked for penetration by dirt, nails, or glass. Tubes have a tendency to thin out from brake drum heat and should be carefully examined for this defect.

The type of repair material which can be used on the tires is governed to a great extent by the fact that such additions at any one point threaten to cause unbalance. However, where through holes are less than $\frac{1}{2}$ in. dia., rivet repairs are indicated, for they affect weight the least and generally outlast the tire itself. Reinforcement by adding fabric is not usual practice for reasons of unbalance given above.

Tires should be removed from service for retreading before the fabric is exposed. Wear of more than two plies of fabric prevents a tire from being retreaded safely, and in

Spot repair on outside of tire.

Result of leaving cans, etc., on runway.

Locked brake melted rubber on this tread.

the case of tires having less than eight plies retreading is not recommended if any damage to the fabric is present. Under normal conditions, tires should be retreaded when not more than 80 percent of the possible tread wear has occurred. It is false economy to expose the fabric through wear before retreading.

Flat spots caused by improper use are good reasons for retreading the entire surface of the tire to prevent unbalance from the adding of repair material at one point only. Many flat spots are started when tires are left exposed to oil drip during servicing of the engine or hydraulic equipment. At these times they should be protected by canvas covers and should then be carefully inspected.

Ground operation or taxiing is a major cause of tire damage. Pivoting on tires exposes the rubber and fabric to an intense twisting stress and often causes small pieces of foreign matter on the ground to be forced into the tread at a time when any scratches or cuts are pulled wide open by the rotary motion of the tire on the surface.

Tire manufacturers recommend that turns should not be sharper than a 25 ft. radius for the inside wheel. Occasionally a pilot may find it necessary to pivot sharply to prevent over-running the field—a practice which has been known to wear through a new tread in two landings, in addition endangering the airplane.

Deep cuts should be repaired immediately.

Re-read time. Tread still covers fabric.

The B.F. Goodrich Airplane of the month

NORTH AMERICAN MUSTANG

Sicily surprise . . . the A-36 . . . our Army's newest attack bomber! Dispatches told the story of its sensational début—a story of roads piled high with Axis trucks, ships afire and sinking, power stations blasted . . . and consternation in the ranks of the Luftwaffe. For this newest version of the famous North American Mustang can bomb with the best and then fight its way back.

B. F. Goodrich products fly on sky fronts all over the world. Silvertown Tires help our planes off with heavy bomb loads. And B. F. Goodrich Bullet-Sealing Fuel Cells protect our pilots . . . help bring them home through storms of ack-ack and swarms of Axis fighters.

As a richly deserved salute to this newest thorn in the Nazi side, we nominate the North American A-36 "Plane of the Month."

In war or peace

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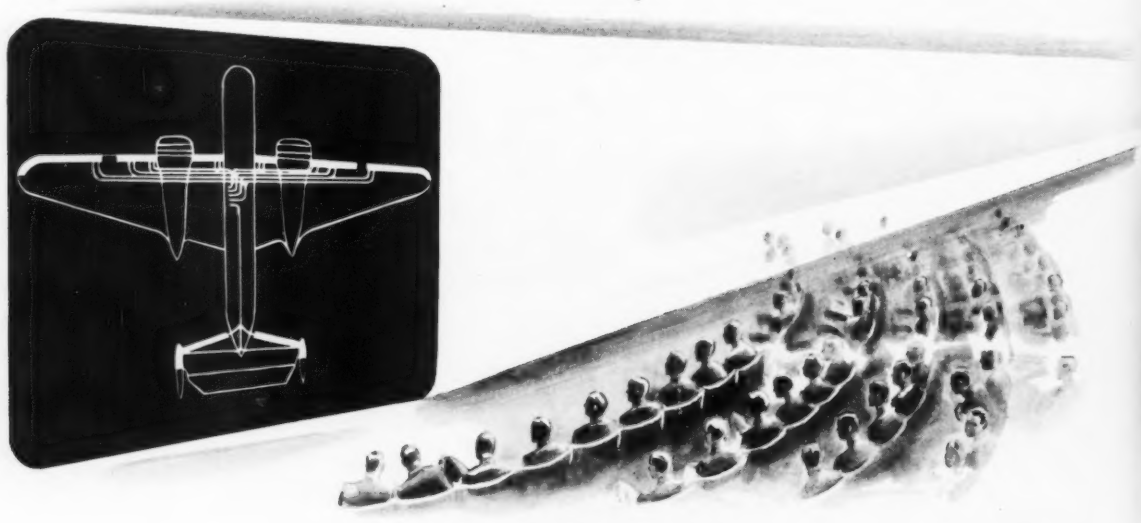
B. F. GOODRICH TRAINING FILMS FOR THE *Aviation industry*



NOW AVAILABLE FREE . . . NEW 16-MM. SOUND MOVIE, "AIRCRAFT DE-ICERS"

Plan now to use this interesting film in your visual training program

Never before has such a complete training aid been prepared on the subject of Aircraft De-Icers. This new sound motion picture is crammed with important facts, yet all are presented in the easy-to-get manner which spells success in any training program.

For maximum ease of presentation, the film is divided into four parts. Each is complete in itself so that you can select the De-Icer information you want to put across and leave out any part not pertinent to your program. These parts and their running times are as follows:

PART I "Ice Formation and De-Icer Operation"—23 minutes

This section deals with the various types of icing conditions encountered and the three basic types of ice formation. Typical working De-Icer sections are shown and described in detail.

PART II "Inspection and Maintenance of De-Icers"—24 minutes

This section presents the maintenance and operation story clearly and concisely. The facts on repair and inspection procedures portrayed are bound to be reflected in greater service and efficiency from your De-Icer equipment.

PART III "Removal and Storage of De-Icers"—12 minutes

Though shorter than the other sections, Part III is vitally important. It shows the proper removal and storage procedure carefully and interestingly, step by step. All personnel connected with this phase of De-Icer servicing can get valuable aid from this film.

PART IV "Installing De-Icers"—28 minutes

In this section, the De-Icer installation story is told in complete detail with clear motion pictures and easy-to-understand comment on every step. Showing this section will give your men the know-how needed to install De-Icers quickly and efficiently.

Prints of any or all parts of this film are available for Army and Navy Training Centers, schools, airlines, and aircraft manufacturers. The films are loaned without charge, but because of the limited number of prints available, the loan period must be restricted to two weeks, unless unusual circumstances warrant an extension.

All civilian requests should be filed with The B. F. Goodrich Company, Akron, Ohio. See order form at right. Army and Navy Air Corps requests should be filed as indicated under "Note" in order form.

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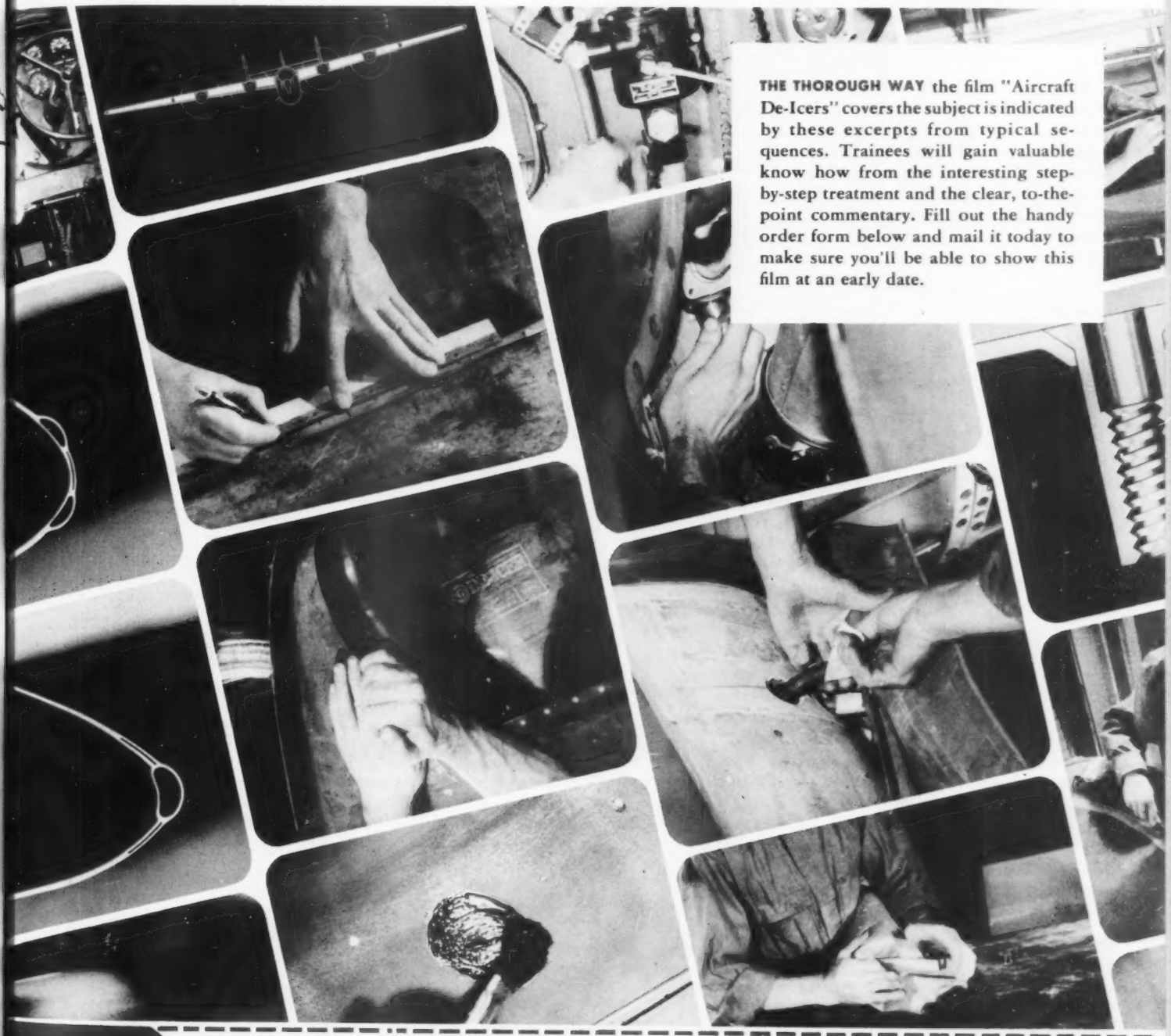
THE KEY TO FASTER DE-ICER TRAINING

FILMS THAT MAKE IT INTERESTING



THE THOROUGH WAY the film "Aircraft De-Icers" covers the subject is indicated by these excerpts from typical sequences. Trainees will gain valuable know how from the interesting step-by-step treatment and the clear, to-the-point commentary. Fill out the handy order form below and mail it today to make sure you'll be able to show this film at an early date.

USE THIS EASY ORDER FORM*

The B. F. Goodrich Co.
Aeronautical Division
Akron, Ohio

***NOTE:** *Film requests of Army and Navy Air Forces must be filed as follows: Army—address requests to Training Aids Division, Army Air Forces, 1 Park Avenue, New York 16, N. Y. Navy—address requests to Commandant of your own Naval District, Attn.: Training Film Officer.*

GENTLEMEN: **Please send me the following part/parts of the 16-mm. sound film "Aircraft De-Icers" for showing on the date indicated below. I understand this film will be loaned free of charge for a two-week period.**

PART 1 ☐ PART 2 ☐ PART 3 ☐ PART 4 ☐

FOR SHOWING (GIVE DATE) 1ST CHOICE _____ 2ND CHOICE _____

_____
(ORGANIZATION) (YOUR NAME)

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(STREET ADDRESS) (CITY) (STATE)

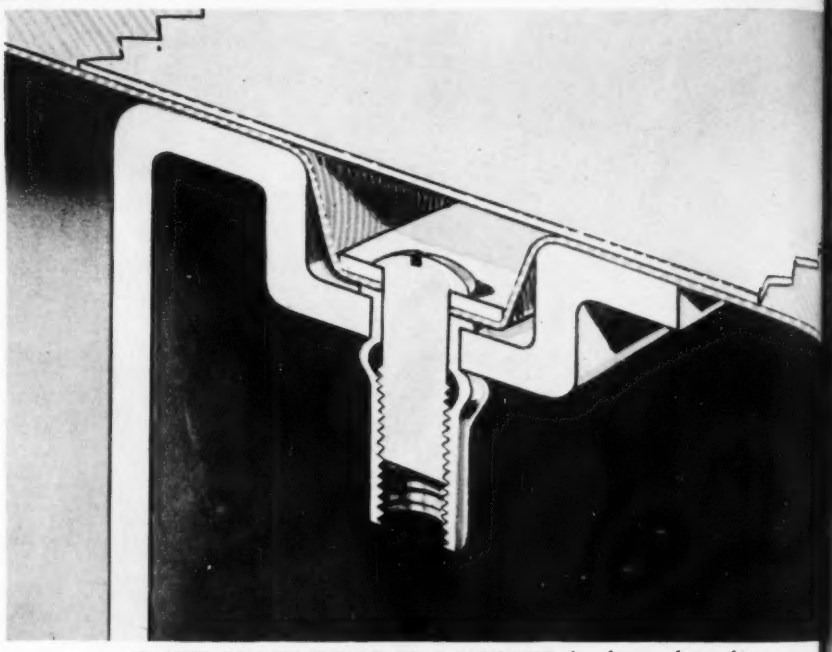
Here's the secret of FASTER "BLIND" FASTENING

USE DUAL-PURPOSE B.F.GOODRICH RIVNUTS AS BLIND RIVETS OR NUTPLATES OR BOTH!

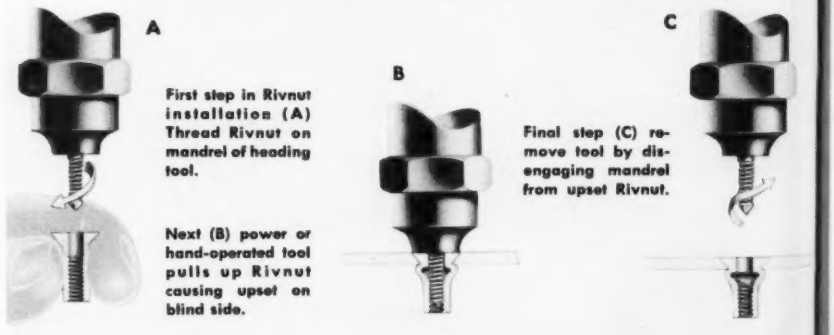
If you use "blind" fastening in any fabricating operation, chances are you can use B. F. Goodrich Rivnuts to great advantage. These internally threaded tubular rivets can be pulled up while working entirely from one side. A bulge or head is formed on the under side of the work which is large enough to resist being pulled through the skin even under heavy load.

LOOK AT ALL THESE FEATURES

The Rivnut is the only one-piece blind rivet that can be used as a nut plate after installation. It is light in weight, low in cost, simple to install. Rivnuts may be inserted in a smaller hole in the skin due to their compact design. When upset, they fill the hole in the skin and have a spring effect under load. In addition, Rivnuts have a wider bearing area than any other blind fastener. Three screw sizes and a complete range of grip lengths make them ideally suited to many uses in secondary and, in some cases, primary structure.



TYPICAL USE OF RIVNUT AS A NUTPLATE is shown here in a cloth-covered control surface assembly. B. F. Goodrich Rivnuts can be installed in metal, plastic, or suitably reinforced plywood air-foils.


A
First step in Rivnut installation (A) Thread Rivnut on mandrel of heading tool.
B
Next (B) power or hand-operated tool pulls up Rivnut causing upset on blind side.
C
Final step (C) remove tool by disengaging mandrel from upset Rivnut.

RIVNUTS AVAILABLE NOW FOR PROMPT DELIVERY!

Facilities for manufacturing Rivnuts have been greatly expanded to accommodate the growing needs of aeronautical and allied manufacturers. This added capacity should make it possible for us to fill all normal orders promptly.

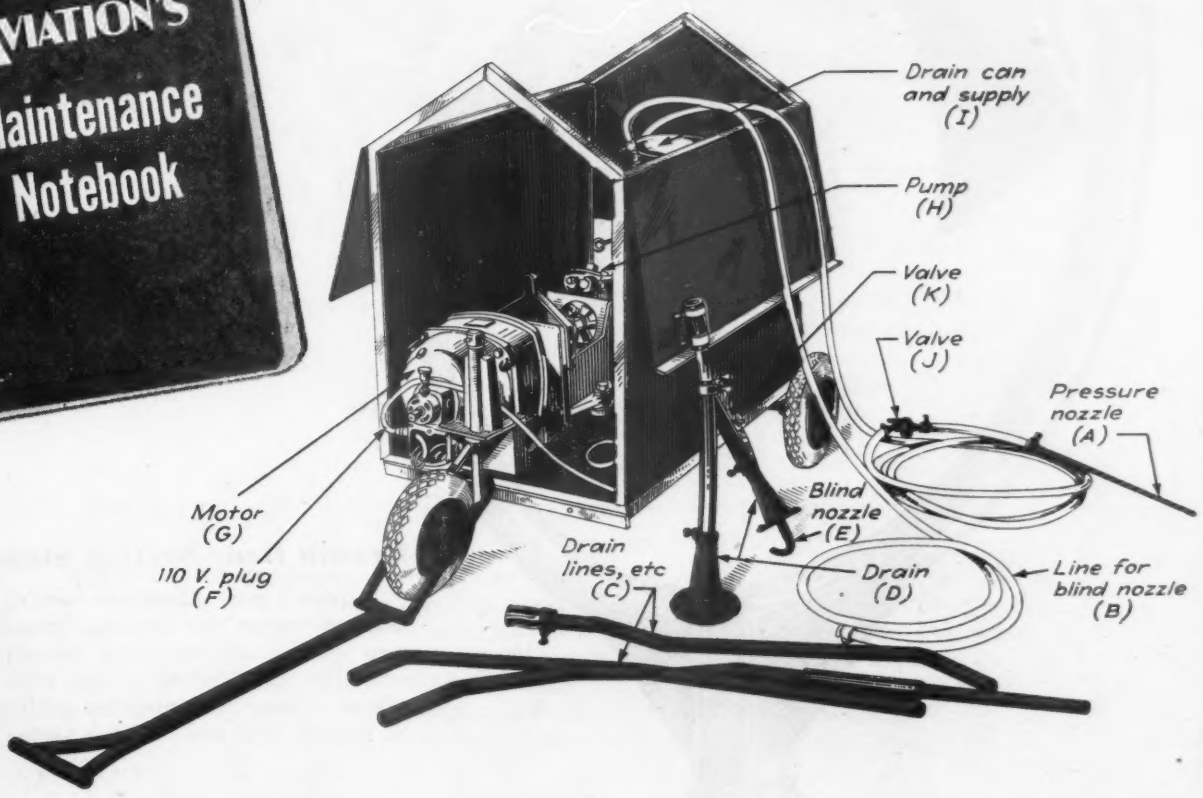
FOR FREE BOOKLET *containing data on Rivnut types, sizes, grip ranges, strength and weight, write today (on letterhead, please) to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

In war or peace

B.F.Goodrich

FIRST IN RUBBER

AVIATION'S Maintenance Notebook



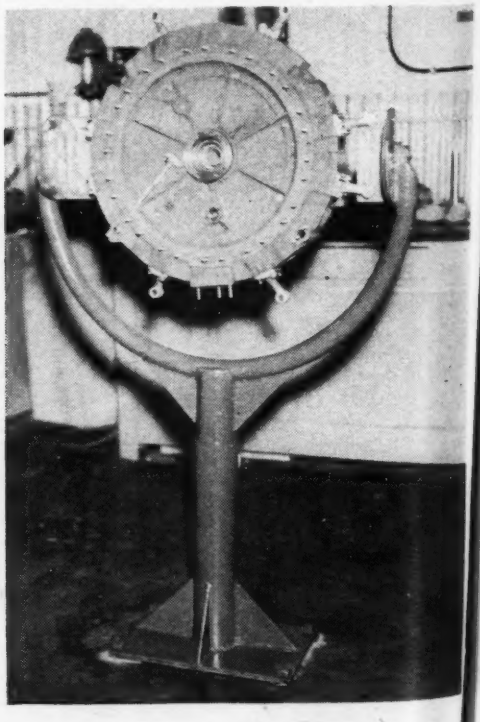
Portable Oil Tank Cleaner

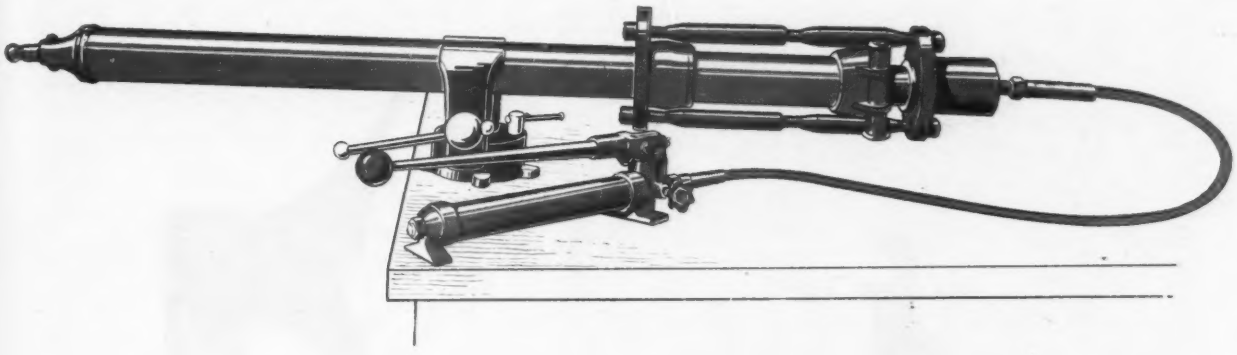
• Braniff Airways' Line Service Crew Chief Carmack Miles built this cleaning unit from salvaged parts. It has turned out to be a valuable piece of equipment. By old system, using compressed air with oleum, 15 gal. of liquid was required for cleaning an oil tank, whereas by using this cleaner the 8-gal. tank of oleum will last almost indefinitely. Though oleum is comparatively cheap, this amounts to a considerable saving over a year. In addition, cleaning time is saved because interior of nacelle is kept clean. Actual cleaning time for a tank has been cut from several hours to about 30 min.

Oleum is circulated by pump *H* driven by 110-v. motor *G*. The liquid is directed into tank through filler opening by nozzle *A*. By maneuvering nozzle, entire inside can be cleaned quickly. Oleum flow is controlled by valve *J*. Nozzle *E*, which protrudes into bottom of oil tank through lower drain holes, can be turned through 360 deg. for reaching blind corners. Flow through *B* is controlled by valve *K*. Oleum and tank deposits drain through drain line *D* back into supply tank *K*, where liquid is recirculated after sediment has been separated by baffles.

Braniff Rear Section Stand

• To permit more convenient working conditions on engine rear sections, Braniff shopmen devised and built this telescopic-base swiveling stand which allows work to be placed in most advantageous position both as regards light and working angle.



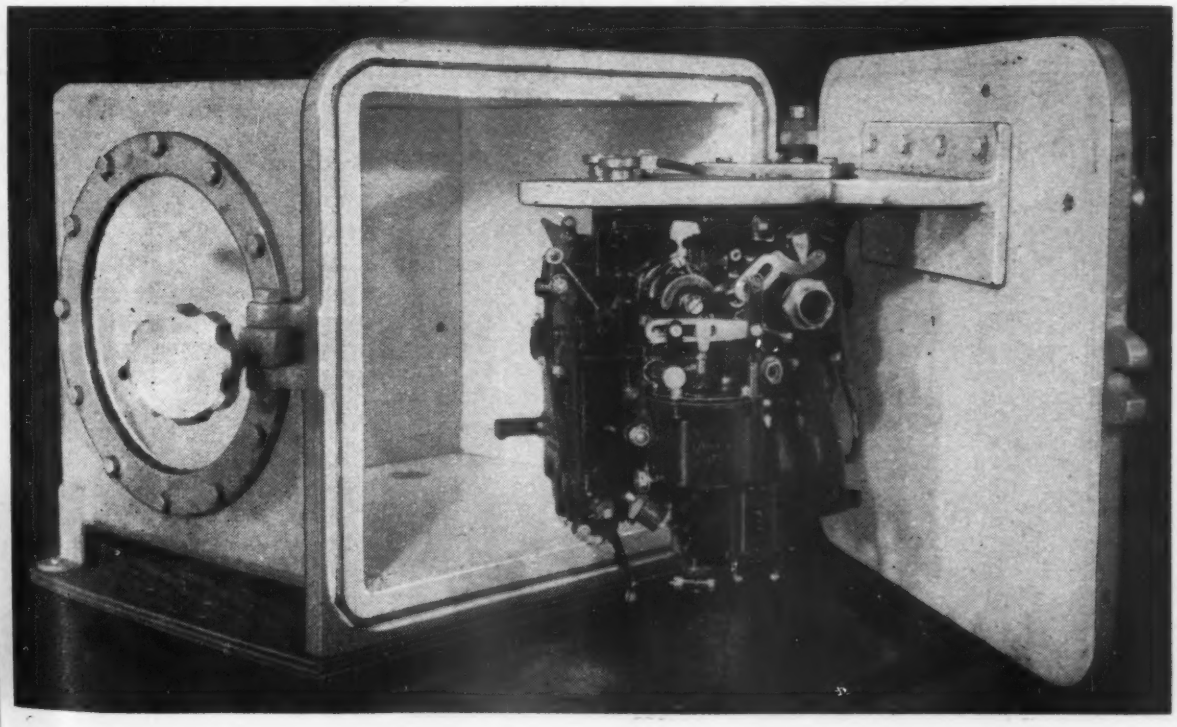


Braniff Pulls Bearings The Easy Way

• For removing tail wheel post bearings on DC-3's, Machinist Lonnie Reedy of Braniff Airways designed and built this hydraulic puller. Not only does this manually operated machine save time and work but its use leaves the parts in better mechanical condition than formerly.

Altitude Chamber

• Carburetor is installed on open door without necessity of reaching into chamber to make connections. Door is then closed and vacuum pump evacuates chamber to simulate any altitude up to 50,000 ft. Operation of parts can be observed through window at left. This equipment has greatly reduced time required in making adjustments. Built and used by Aircraft Repair, Ltd., Edmonton, Alta.



TCA Assembly Dolly

• Having its tilting angle controlled by gears and locked with a pin—shown at right—this assembly dolly, built from scrap, was made at company's Winnipeg shops.

Hydraulic Test Unit

• Chicago & Southern built this hydraulic unit for hangar testing of airplane systems. By making two union connections, entire hydraulic mechanism of plane can be tested accurately.

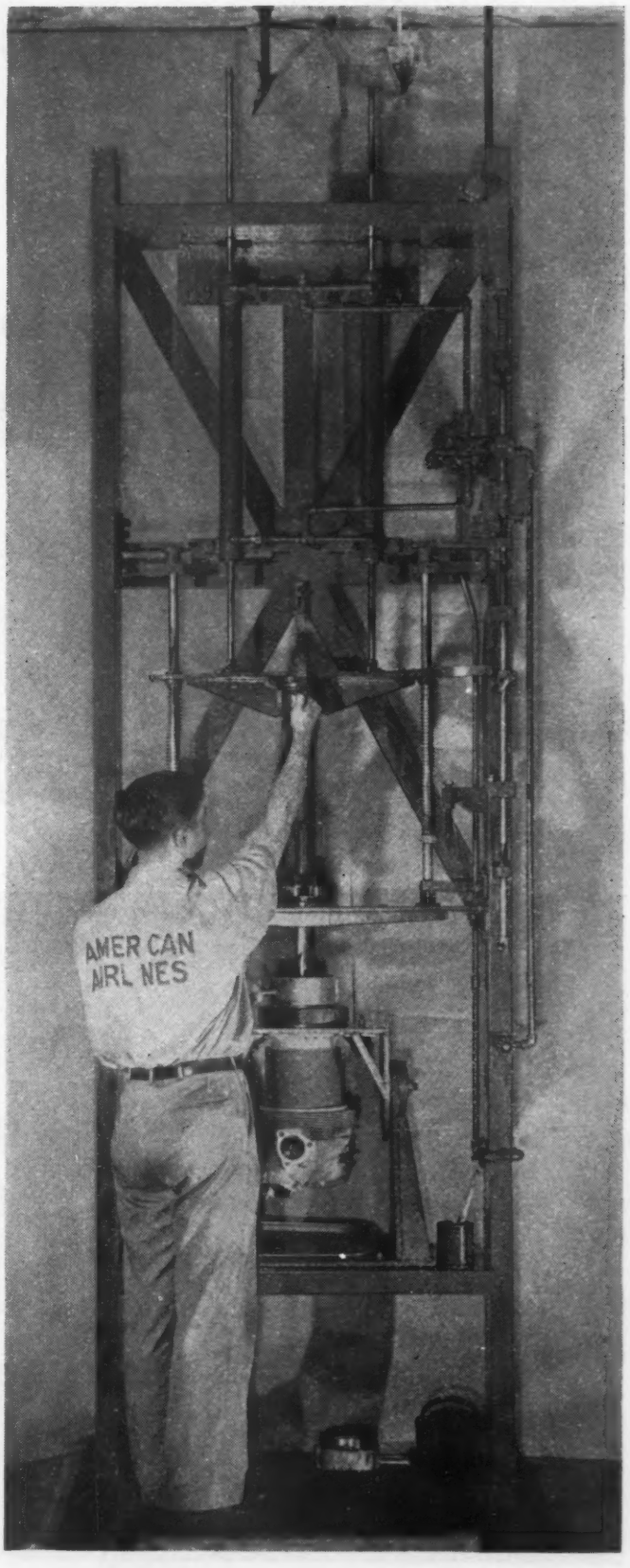
American Airlines Builds Cylinder Lap From Scrap

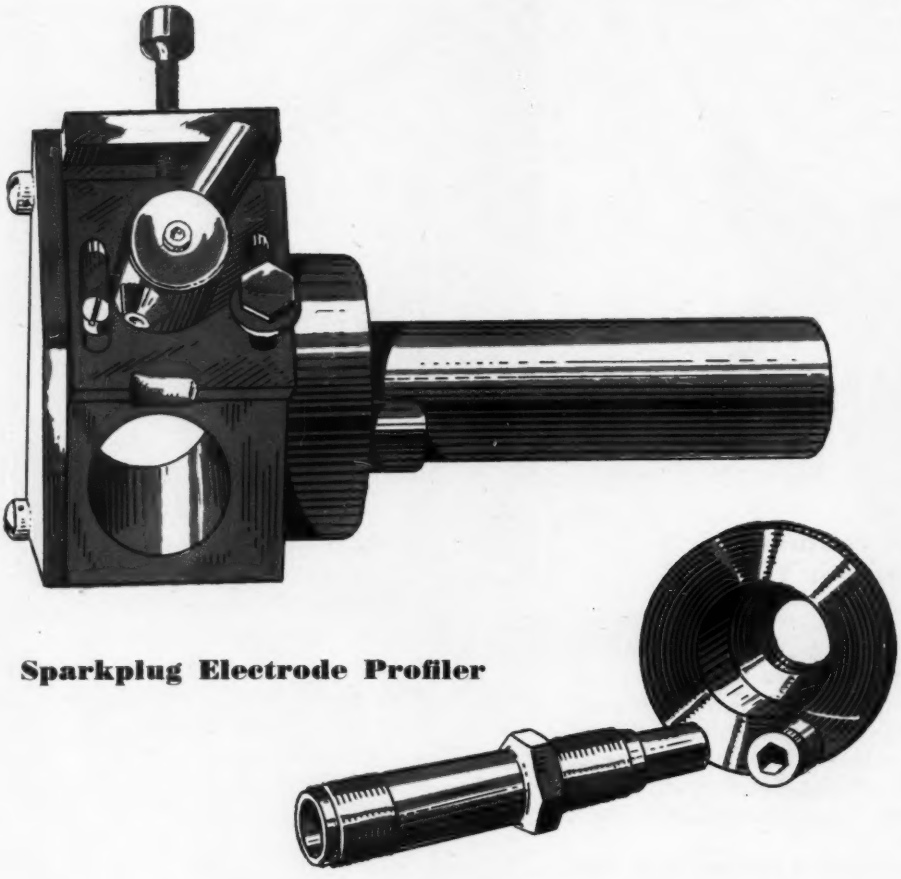
• Cylinders which have been in use for some time are not smooth, nor are they smooth even after they have been reground in overhaul. Lapping insures smoothness of lubrication. Lewis H. Trainor's machine is an original model not duplicated in any airline hangar, though several shops have small, bench models.

The cylinder lapping machine, built from material which was available in the machine shop, is a stand about 12 ft. high and 4 ft. wide. Suspended from a crosspiece is a 3-ft. piece of ordinary 2-in. tubing which is moved up and down by a valve. The valve, incidentally, was salvaged from a four-way landing gear selector valve. Attached to bottom of tubing is a removable, round piece of metal. This is main section of tool—part which actually does lapping of cylinder.

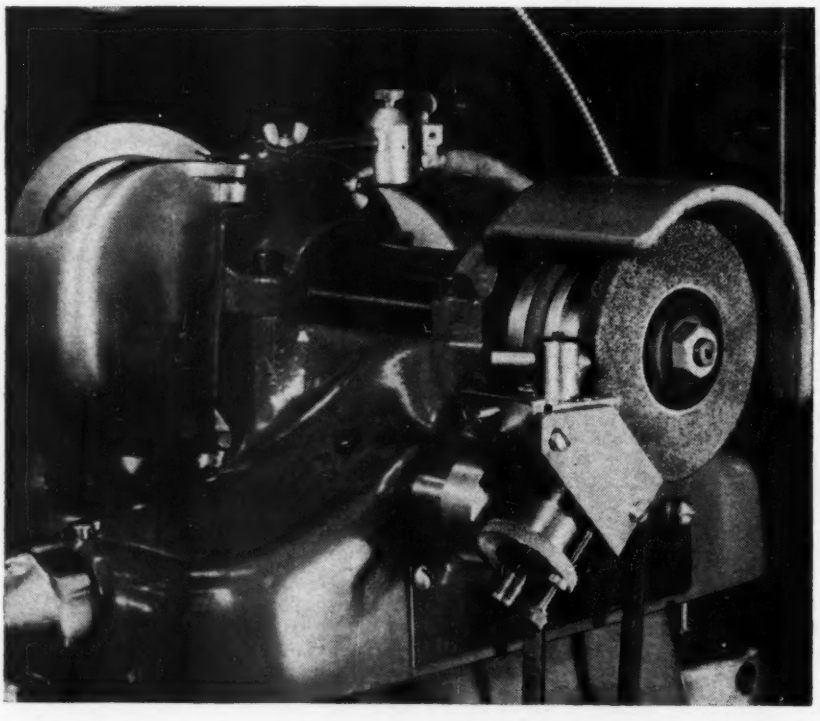
After a cylinder has been thoroughly inspected for flaws, it is sent to lapping machine for finishing. Cylinder is fixed to stand, switch turned on, and round lapper moves up and down inside cylinder, giving cylinder wall a highly polished, smooth surface. This round piece may be removed, and a different tool head installed for lapping of different sized cylinders.

Lapping operation takes about three minutes, and though this makes standard maintenance work on a cylinder three minutes longer than formerly, lapping is an improvement in maintenance methods, giving added strength and durability to a vital, delicate aircraft part.





Sparkplug Electrode Profiler



• Continental Air Lines designed and built this electrode profiler for use on a valve grinder when servicing sparkplugs. Depth of cut is regulated by small knurled-head screw at side of retainer. Attachment fits into hole for handrest and is prevented from turning by pin which fits into face of grinder base casting.

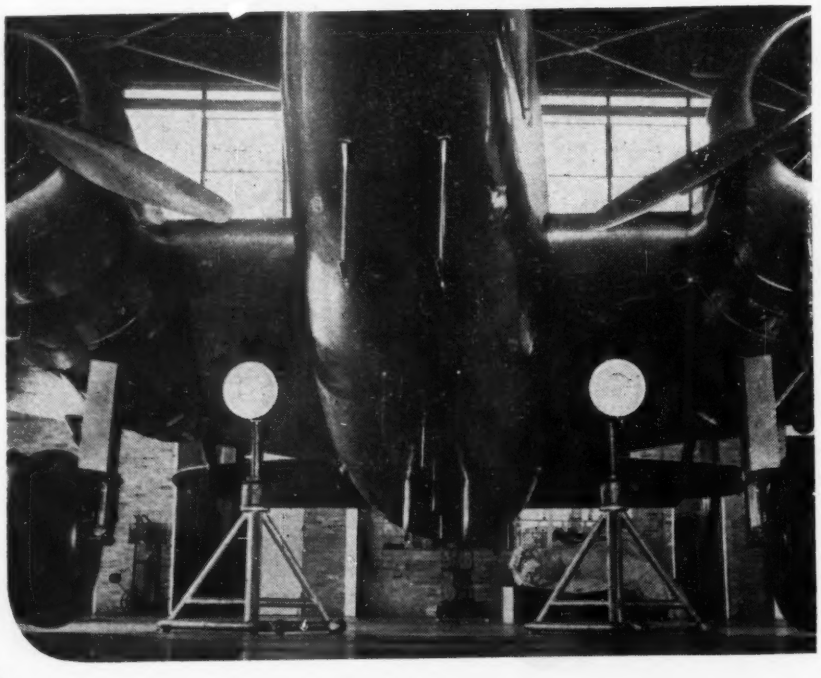
Braniff Uses Wood To Save Metal

• Braniff Airways uses this all wood cylinder assembly storage stand, saving space and critical materials.

Collector-Ring Jig Used by TCA

• Designed and built at Trans-Canada Air Lines' Winnipeg base, this stand provides rigid support and gives easy access to exhaust collector rings to be built up or repaired. Turntable can be rotated and locked. Maintenance problem with this type of ring is the excessive wear in flexible ball joints, found to be due to rotation of ball from vibration. New joint, with finger which allows flexibility but prevents turning of joint, is being designed by TCA.

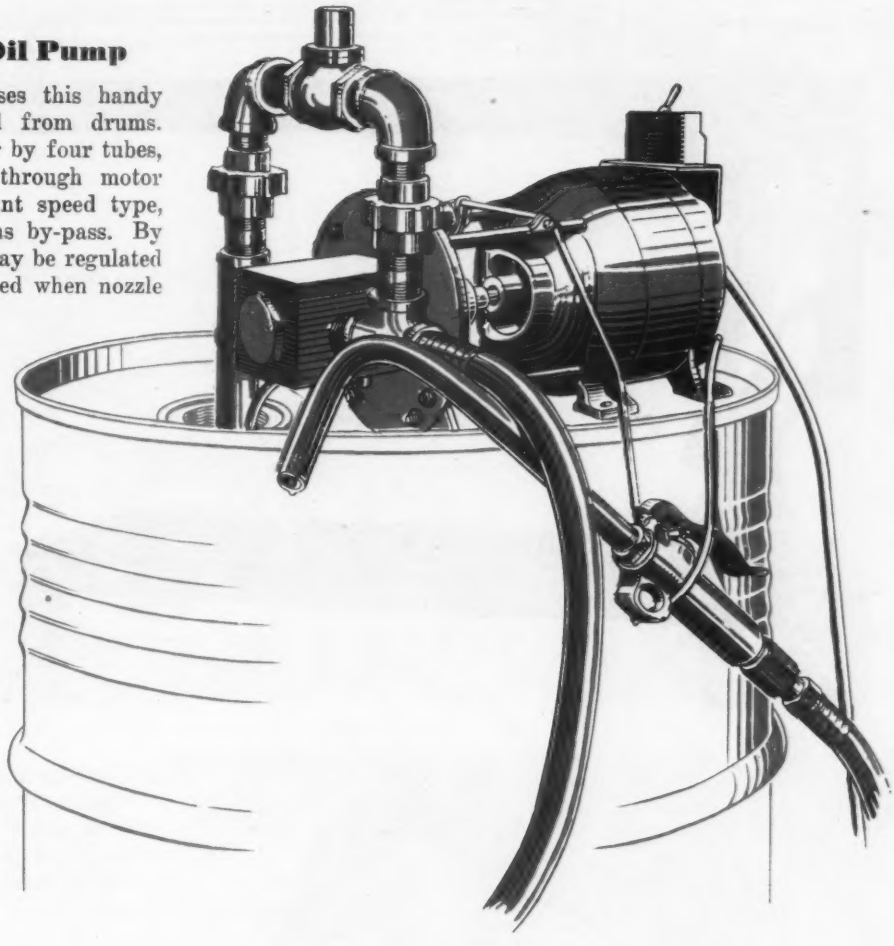
Aircraft Scale by TCA



• Hydraulic weighing head to be placed on jacks under aircraft incorporates an oil pressure chamber made of strong copper corrugated sheet diaphragm with boss bolted on to bear weight. Filler plug is at right. Oil line transmits oil pressure to gauge. One of these is put under each wing as plane is jacked up. A third scale under tail completes the process. Unit designed by C. H. Wilson, machine shop foreman, TCA base, Winnipeg.

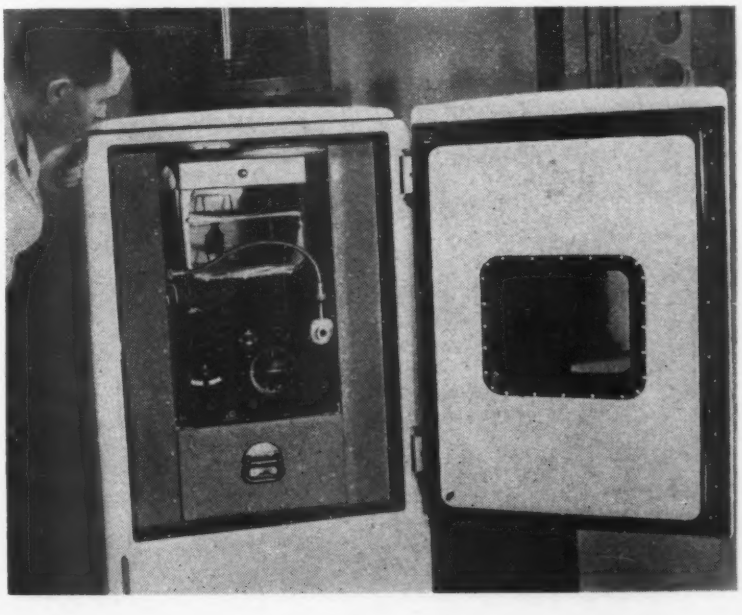
Portable Fuel and Oil Pump

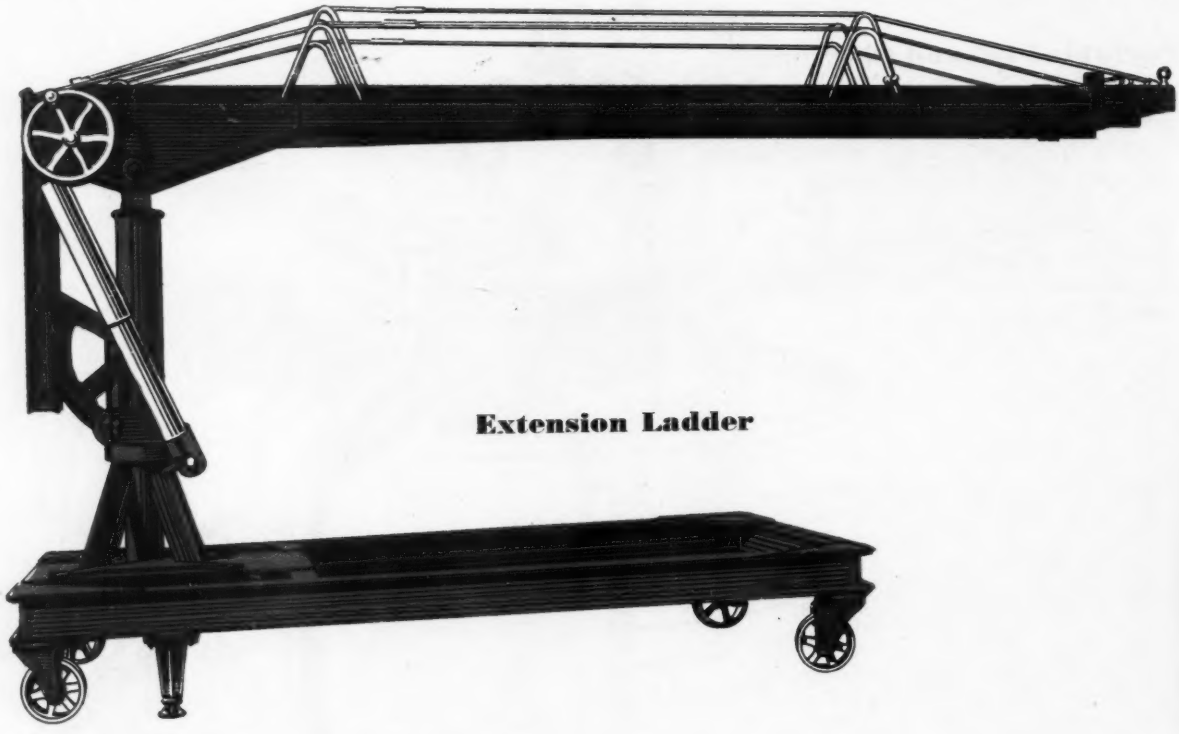
• Continental Air Lines uses this handy pump for transferring oil from drums. Pump is bracketed to motor by four tubes, slid over extension studs through motor body. As motor is constant speed type, valve above pump serves as by-pass. By opening valve, flow of oil may be regulated and pressure on hose relieved when nozzle valve is closed.



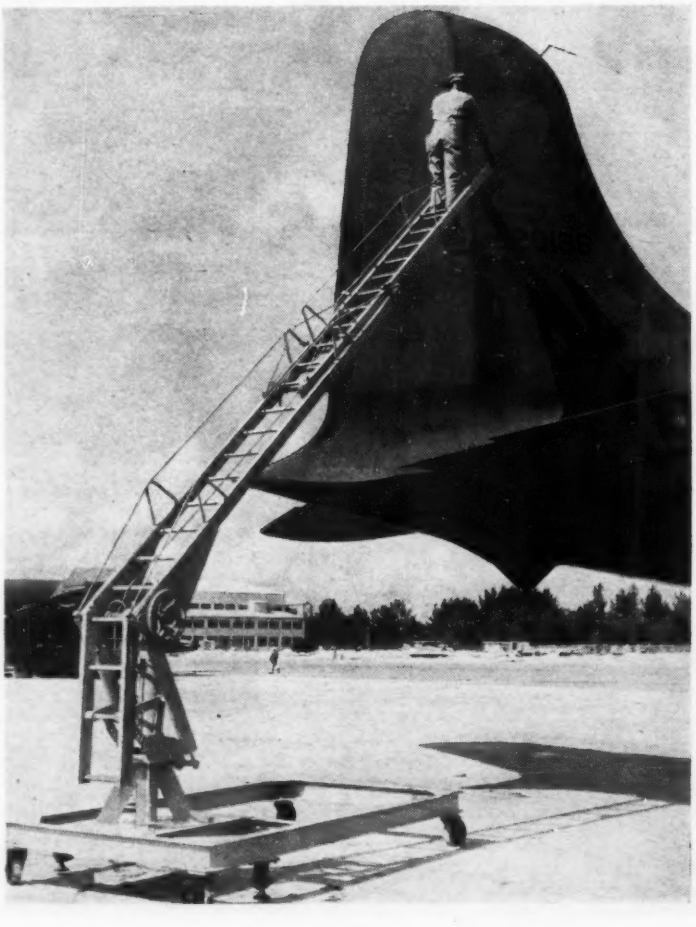
Instrument Ice Box

• United Air Lines has installed a vacuum pump and extra electric motor in the base of a household refrigerator for instrument testing under sub-zero conditions at high altitude pressures. Beneath shelf on which instruments are tested there is a drawer for dry ice and another above it. To prevent observation window from icing up, it is made double, with a 2-in. air space. Temperatures as low as 90 below zero have been obtained with instruments not requiring air flow, 35 below zero when air flow is required.

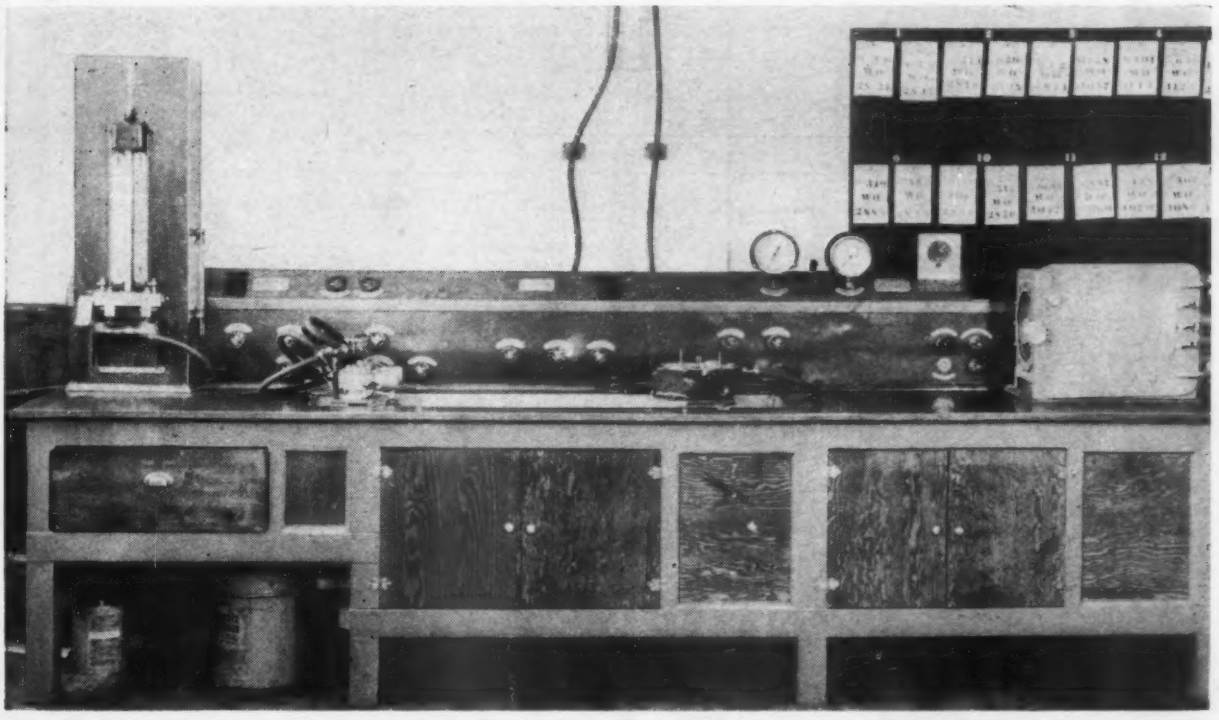




Extension Ladder

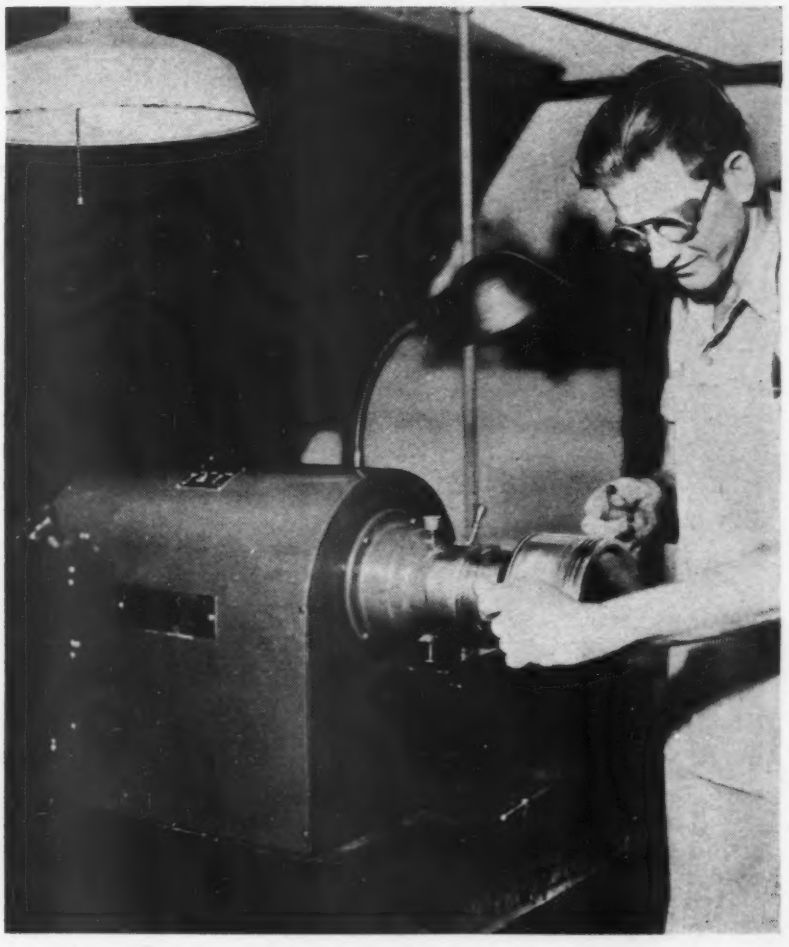


• For working on airplanes too high for ordinary stepladders, Pan American designed and built this extension ladder with a reach of 26 ft. It was intended particularly for working on the C-54 but doubtless found many other uses. Inverted screw jacks are used beneath the frames to prevent movement when working.



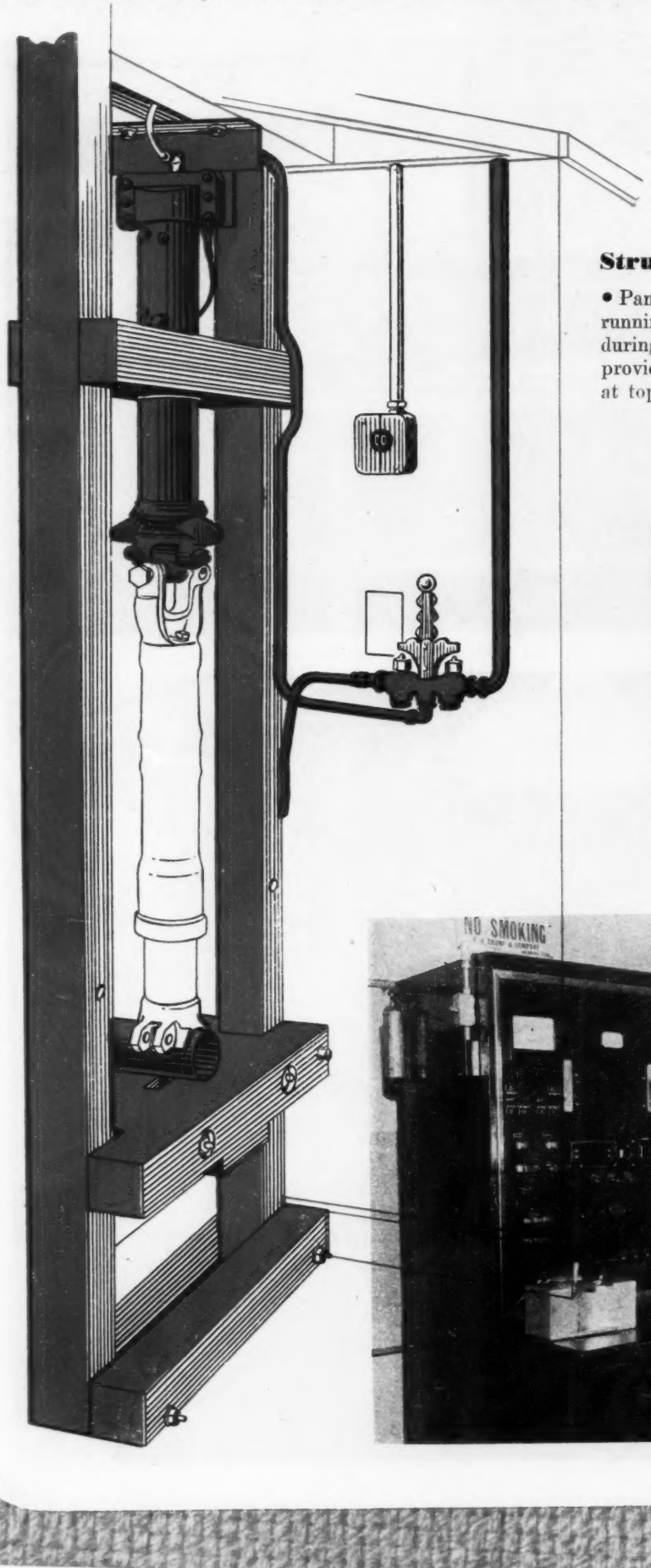
Test Bench For Carburetors And Fuel Pumps

• Aircraft Repair, Ltd., Edmonton, Alta., designed and built this bench. At left is double flowmeter for calibrating carburetor jets. Next is mounting for run-in of fuel pumps. In center carburetors are checked for float level and needle operation. At right is altitude chamber. Vacuum pumps, fuel pumps, drain tanks, etc., are in space below bench.



Piston Cleaner

• Eastern Air Lines cleans pistons by using a variable speed machine equipped with quick-acting chuck.

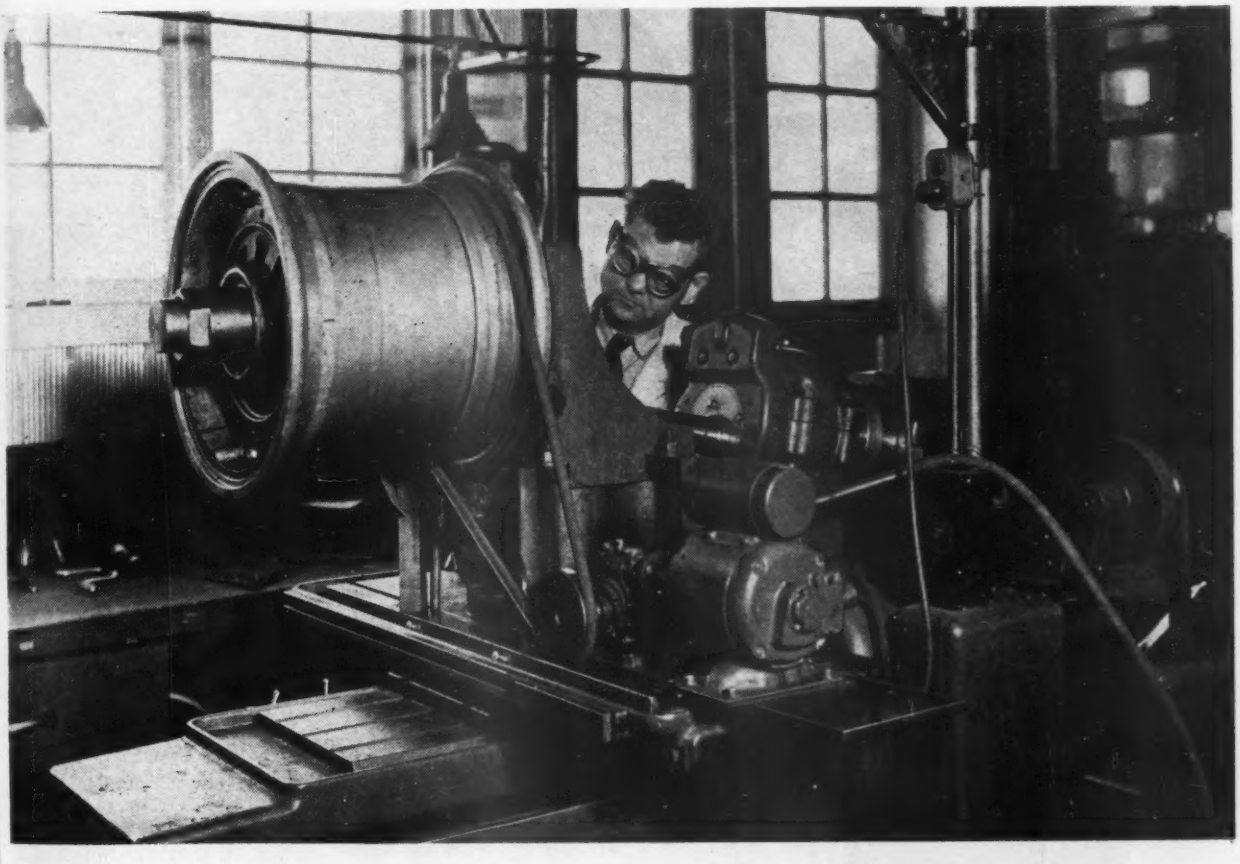


Strut Running-In Device

• Pan American uses this gadget for running in oleo struts to prevent leakage during operation. The valve at right provides pressure to operating cylinder at top.

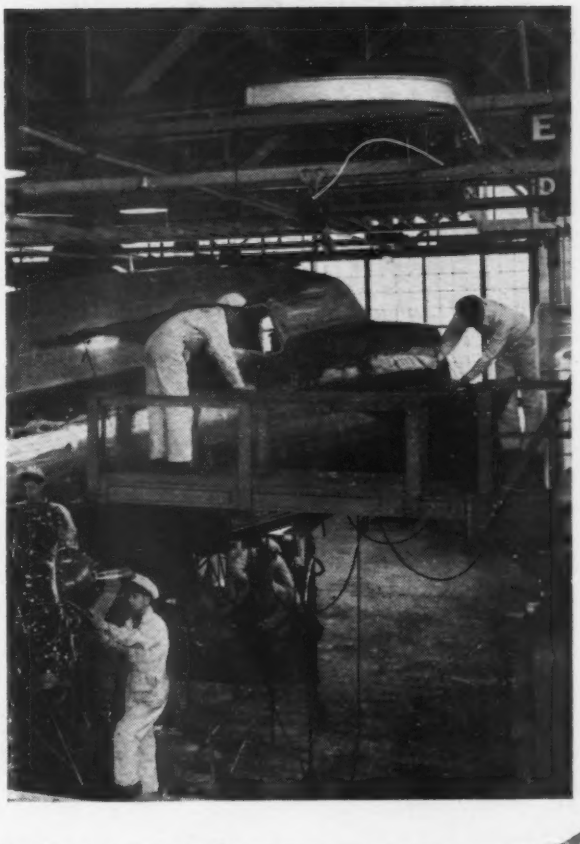
Chicago & Southern's Engine Accessory Testing Bench

• Center section of panel is for control of a 5 hp. variable speed motor which is mounted directly behind control panel with shaft projecting through. On this is a mounting fixture with various adapters for accessories to be tested. Left section of panel handles all electrical accessories, such as generators, control position mechanisms, etc. Right section takes care of pressure and vacuum pumps.



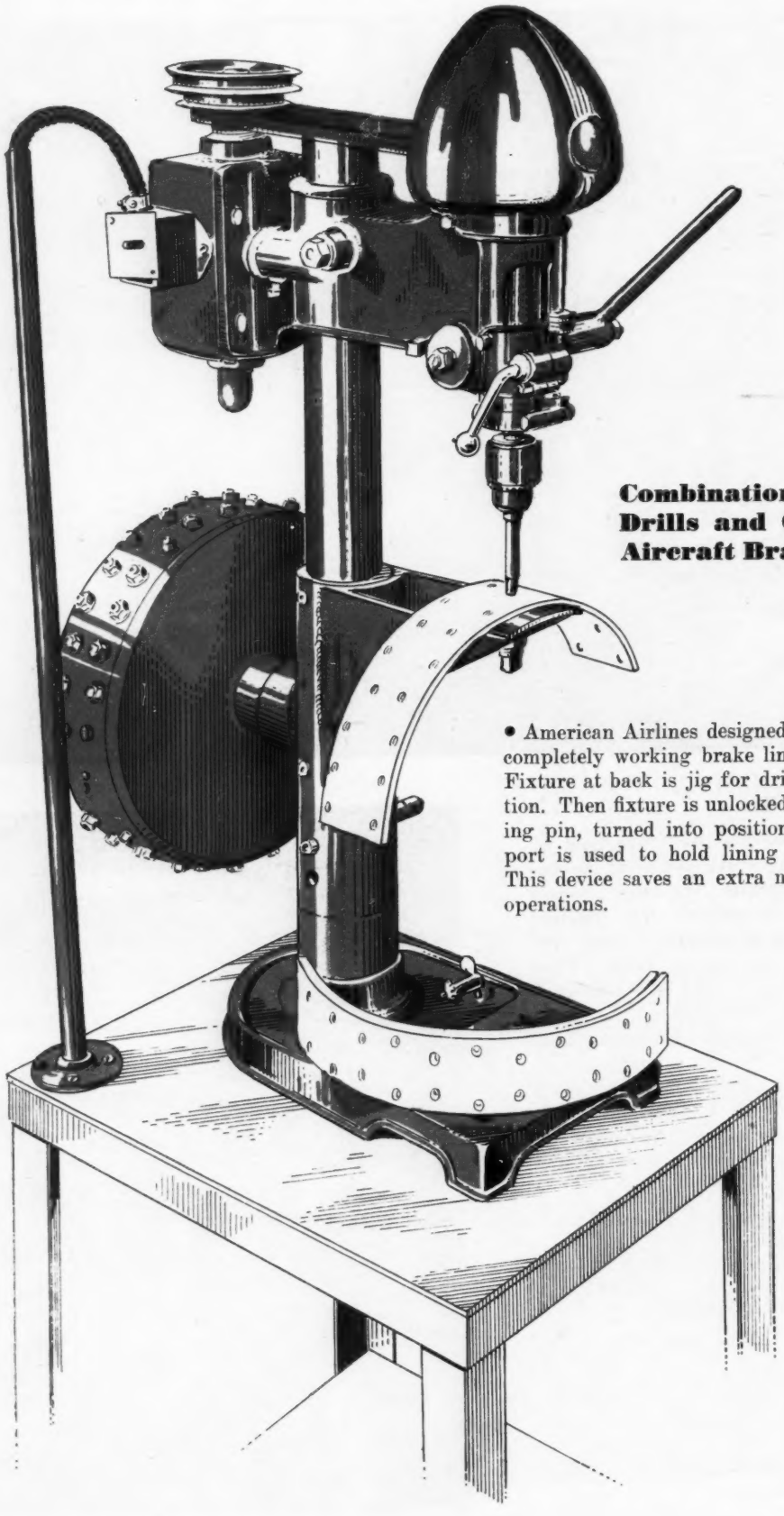
Brake Drum Grinder

• This Heald cylinder grinder has been revamped by United Air Lines for grinding brake drums at its central maintenance base at Cheyenne. The table traverse is automatic and the feed is manual. The original power application to the moving carriage is used. All parts for the conversion were salvage parts. They included a spindle for holding the 1700 by 16 wheel, an angle plate, four blocks for holding the angle plate, a small motor-driven reducer for turning the wheel, a plate for mounting the motor and reducer, two wedges for raising the spindle to get the grinding wheel into the bolt heads on the 1700 by 16 wheel, and a belt pulley for the spindle drive. The conversion was designed by United's engineering staff at the Cheyenne maintenance base.



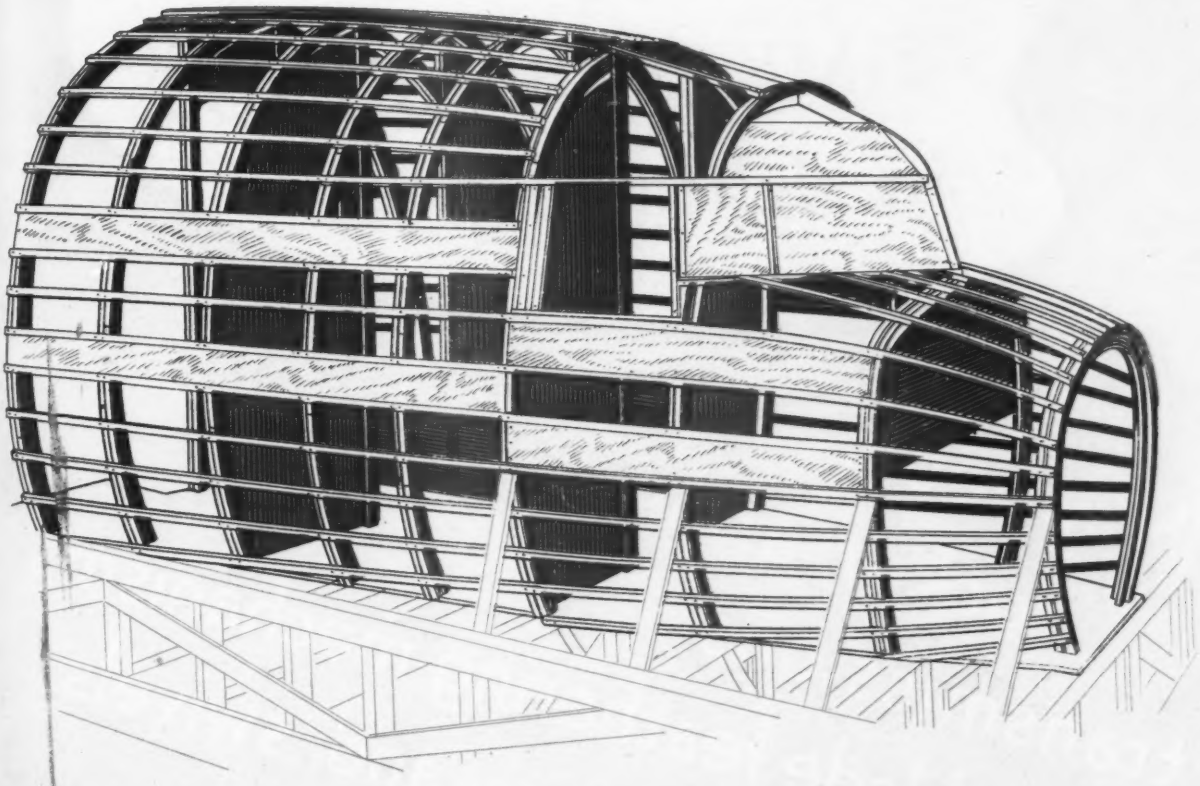
nstrument Repair Platform

United Air Lines use a mezzanine platform for serv-ing instruments on *Mainliners* at Cheyenne, Wyo. A ot in platform directly in line with overhead track ermits moving of parts past platform. Instrument pair shop is at back of balcony obviating need for imbing up and down when working on instruments nose or pilot's instrument board.



Combination Attachment Drills and Counterbores Aircraft Brake Linings

• American Airlines designed and built this fixture for completely working brake linings on a single machine. Fixture at back is jig for drilling lining in first operation. Then fixture is unlocked on center post by removing pin, turned into position shown and curved support is used to hold lining while it is counterbored. This device saves an extra machine and two handling operations.



Wood Radio-Work Mockup

• This wood mockup of a DC-3 cockpit enables Pan American Airways' radio shop at Miami to plan new radio installations and alterations without tying up aircraft on the ground. Technicians plan and install their work in this mockup and then transfer the completed work to the plane itself. By this means the plane is available for operations until the crew is ready for actual installation work.

"Lodestar" Tailwheel Lock

• Earl G. Peters, crew chief for Continental Air Lines received $50 award for this invention which enables the lock to be renewed by replacing a small part instead of the entire cylinder. Saving much valuable time, this device permits the company to make replacements in its own shop instead of waiting for them to come from the factory.

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propeller blade feathering mechanisms
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vertical columns . .

SOME of these applications, for example wheels, have been equipped with Timken Bearings for years and are standard equipment. At other points we have made comprehensive studies and have definite bearing recommendations to offer. On still other applications preliminary studies and tests are being rapidly completed. Consult us with your problems.

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Flight Testing With a Thrust Meter*

By GEORGE W. BRADY,
Curtiss-Wright Corp. Propeller Div.

Method precisely gages engine and propeller performance in air, and calculations on ground provide coordinated check.

THREE PRINCIPAL ITEMS must be known in order to obtain shaft thrust efficiency: Shaft thrust, shaft horsepower, and airplane velocity. These factors are then used in the formula—

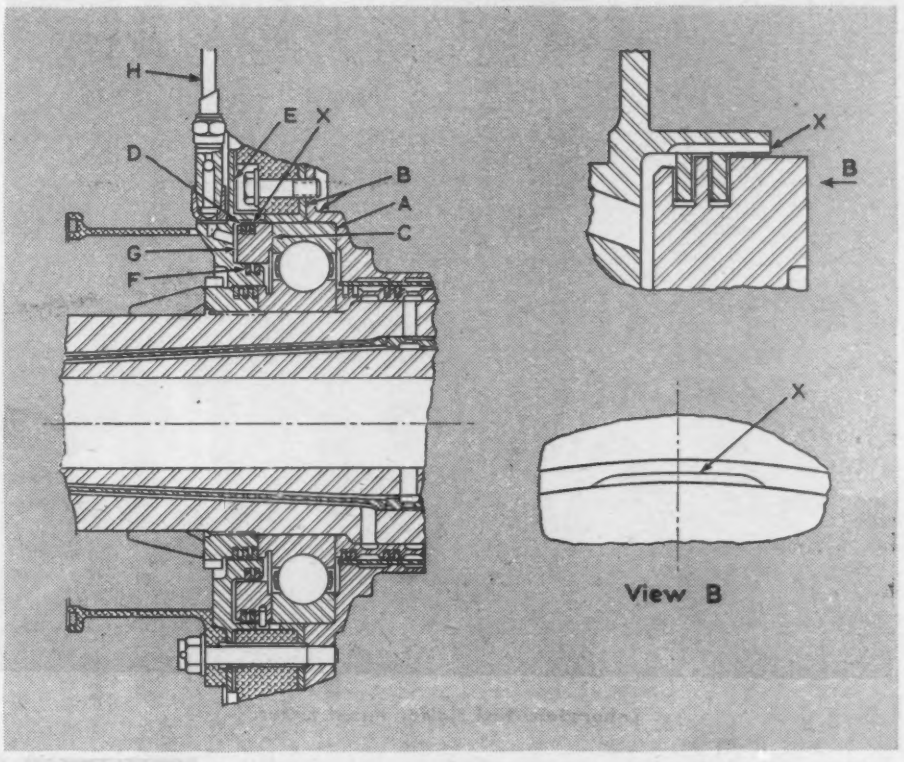
$$\eta_p = \frac{\text{Shaft thrust} \times \text{Airplane velocity}}{\text{Engine power}} = \frac{T_s \times V}{P}$$

Since horsepower is readily measured by torquemeters and airplane velocity is easily obtained, the instrumentation problem becomes simply one of developing a suitable thrust meter. Hub design in controllable pitch propellers precludes the incorporation of a meter in that mechanism, and determination of tensile stress in the shaft is excluded through lack of measurement space; hence, the method of measuring the end thrust on the movable propeller shaft bearing was decided upon as the only feasible system.

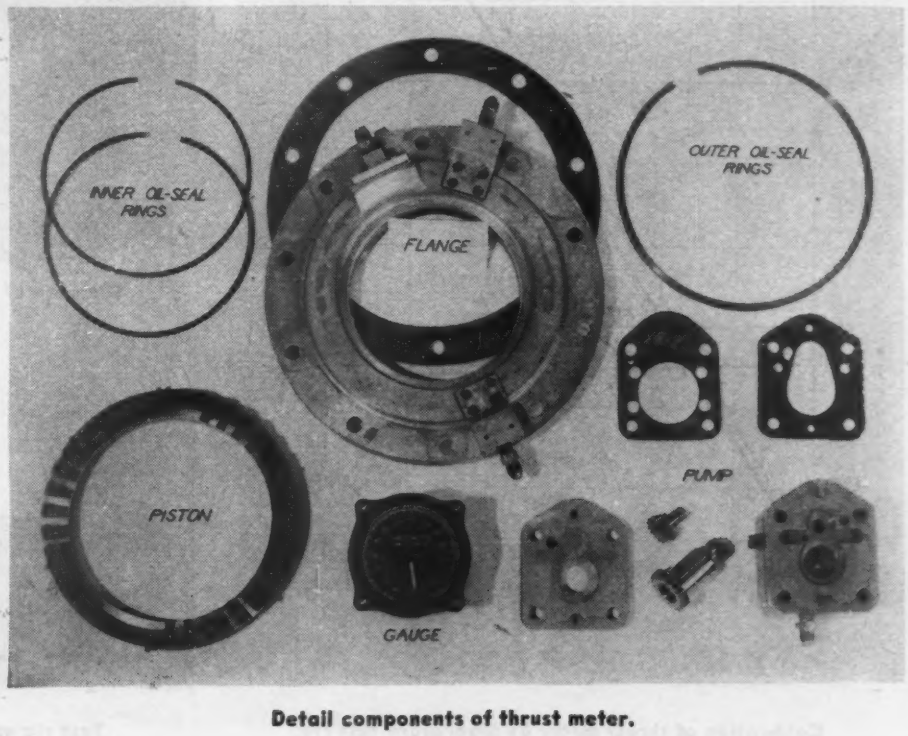
A hydraulic piston with variable-area orifice was adopted as most satisfactory. Referring to the accompanying sectional drawing, the outer race of thrust bearing *A* is given a clearance of .004 to .006 in. to permit it to slide freely. Housing *E* replaces the usual cover and is fitted with annular piston *C* which bears against outer race of thrust bearing. Rings *D* and *F* seal cylindrical space *G* between piston and housing into which oil can be pumped. Six orifices *X* in the housing allow the piston to find a position where oil pressure through duct *H* just balances thrust. Then by multiplying psi. by piston area, thrust may be computed.

Oil is supplied by positive displacement gear pump, and pressure readings are taken by a gage reading 30–180 psi., which allows thrust measurements up to 2,500 lb. Oil lines are electrically heated to prevent congealing. Since practice has shown that corrections were required in gage readings, a laboratory calibration rig was constructed and used for this purpose.

The Navy loaned an F2A-2 airplane for flight tests. This plane was equipped with a Wright R-1820 engine with .667 gear ratio. Because erratic readings were obtained in first tests, it was found necessary to use a ground calibration rig for application of a measured thrust while the engine was running. During tests it was found advisable to make corrections for each engine used because of the construction of the propeller shafts. It will be noticed that the oil pressure acts on the internal taper of the shaft, causing thrust. The oil also acquires additional centrifugal pressure in passing out-



Section through engine nose with thrust meter installed.



Detail components of thrust meter.

*Abstract of paper presented at SAE National Engineering & Production Meeting, Los Angeles, Sept. 30, 1943.

Laboratory test rig for thrust meter.

ward through passages in the shaft. Both of these factors must be allowed for.

Another possible cause of error might have been the deflection of the engine reduction gears, causing a fore and aft load. But careful checking showed no noticeable effect of this sort.

Typical procedure in correcting readings for true shaft thrust is as follows:

1. Correct observed thrust meter for gage calibration.

2. Using pressure from (1), obtain indicated thrust from thrust meter calibration.

3. Correct observed intershaft pressure for gage calibration.

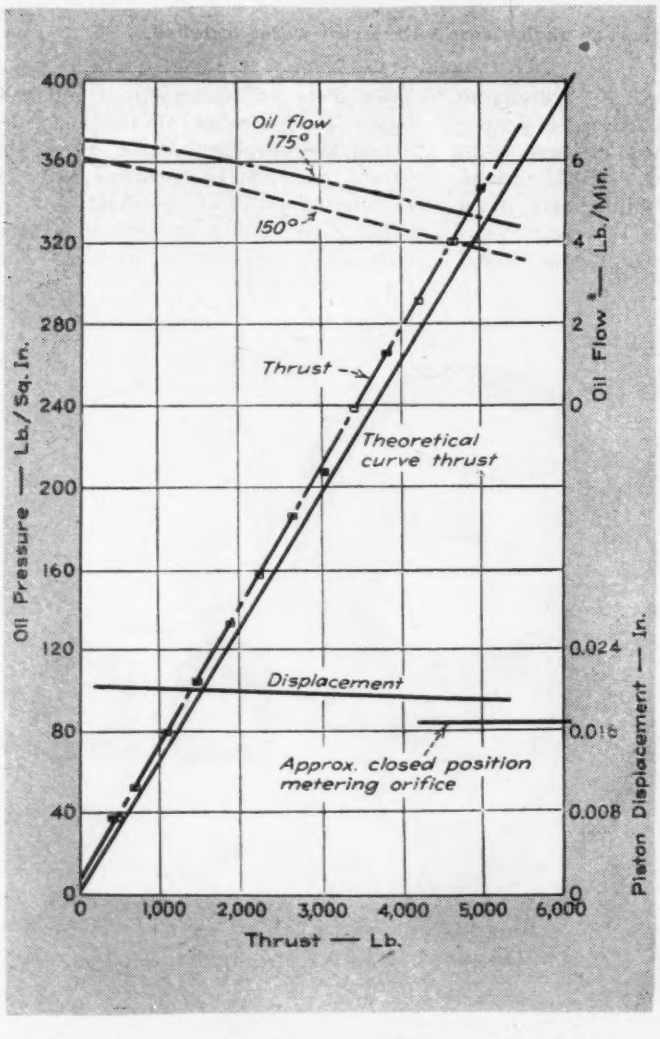
4 Read correction to intershaft pressure for centrifugal boost for observed engine speed.

5. Calculate thrust on propeller shaft due to oil pressure effect by multiplying effective area by difference between (3) and (4).

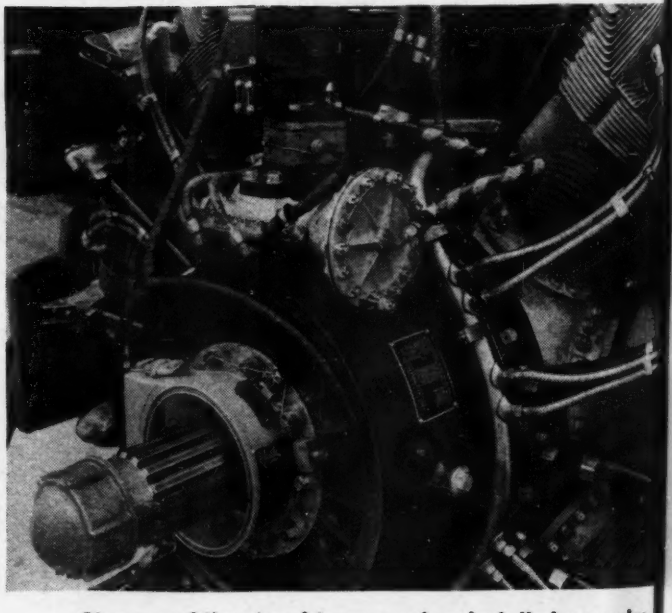
6 Calculate component along propeller shaft axis and propeller shaft weight, using observed inclination of shaft from horizontal.

7. Calculate corrected shaft thrust as (2) minus (5) plus (6).

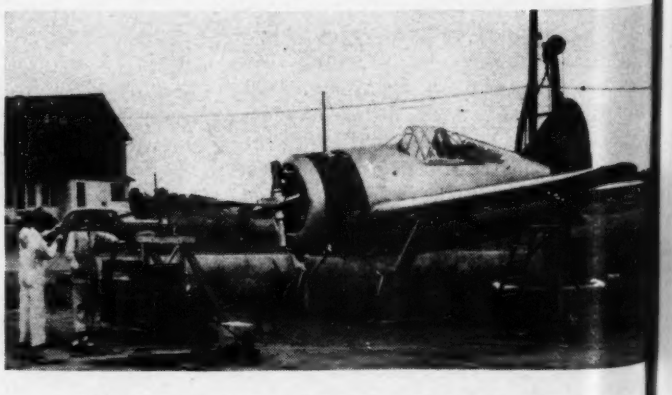
Flight tests were to be made at



Calibration of thrust meter by laboratory test rig.



Close-up of thrust and torque meters installed on engine.



Test rig used for calibrating thrust meter on airplane.

speeds between 150 and 400 mph., and the level flight speed of the airplane was 310 mph., so it was necessary to make tests while diving. For this purpose a photo-observer was used which made simultaneous recordings of all instruments. Accuracy of readings was believed to be within 20 lb. for thrust, approximately 1 percent for speed, rpm., and hp., and within comparable limits for other readings. The only non-standard instruments were the pitch indicator and gyro-inclinometer. The inclinometer was a modification of a Sperry directional gyro mounted on its side to give inclination from horizontal of shaft axis to enable the weight component along this axis to be calculated.

The pitch indicator was specially developed to give blade angle. The transmitter on the propeller gives an impulse for each fraction of a degree pitch change and the indicator escapement counts the number of change increments in each direction, thus providing an index of the movement of the blade.

TABLE I—Range of V/nD and EHTS*

R.P.M.	2,100	2,400	2,700
B.h.p.	850	850	850
Altitude	14,000	14,000	14,000
B.m.e.p.	176	154	137
C_p	.239	.159	.112
V/nD for			
V = 160	1.007	.880	.782
V = 200	1.26	1.10	.978
V = 250	1.57	1.374	1.22
V = 300	1.89	1.65	1 465
V = 350	2.20	1.924	1.710
V = 400	2.52	2.20	1.955
nD	732	839	941
EHTS* for			
V = 160	810	918	1,024
V = 200	831	937	1,039
V = 250	862	963	1,060
V = 300	902	996	1,091
V = 350	945	1,035	1,129
V = 400	991	1,080	1,166

*Effective Helical Tip Speed.

TABLE II—Calculated Efficiency

Velocity — T.A.S.	160	220	300	400
Altitude — Ft.	14,000	14,000	14,000	14,000
B.h.p.	850	850	850	850
R.p.m.— engine	2,400	2,400	2,400	2,400
R.p.m.— propeller	1,600	1,600	1,600	1,600
C_p	.1594	.1594	.1594	.1594
V/nD	0.880	1.208	1.650	2.200
ηChart — percent	78.5	86.0	88.5	89.0
αdeg.	9.2	5.5	2.5	−0.2
Fa	1.255	1.132	1.051	1.00
FB	.961	.961	.961	.961
Fr	.902	.969	.987	.964
η — percent	68.1	80.1	84.0	82.4
$\Delta\eta$ (Interf.)	−1.0	−1.0	−1.0	−1.0
η_p — percent	67.1	79.1	83.0	81.4

TABLE III — Correction for Apparent Thrust and Efficiency

a) f_2 = 0.25				
Velocity — T.A.S.	160	220	300	400
η_a — percent	81.0	91.0	96.5	94.8
$f_{\Delta T_a}$	.935	.935	.935	.935
$f_{\Delta D_s}$	.971	.978	.982	.986
η_p — percent	73.6	83.3	88.6	87.4
b) f_2 = 0.50				
Velocity — T.A.S.	160	220	300	400
η_a — percent	81.0	91.0	96.5	94.8
$f_{\Delta T_a}$	.875	.875	.875	.875
$f_{\Delta D_s}$	.971	.978	.982	.986
η_p — percent	68.9	77.9	82.9	81.9

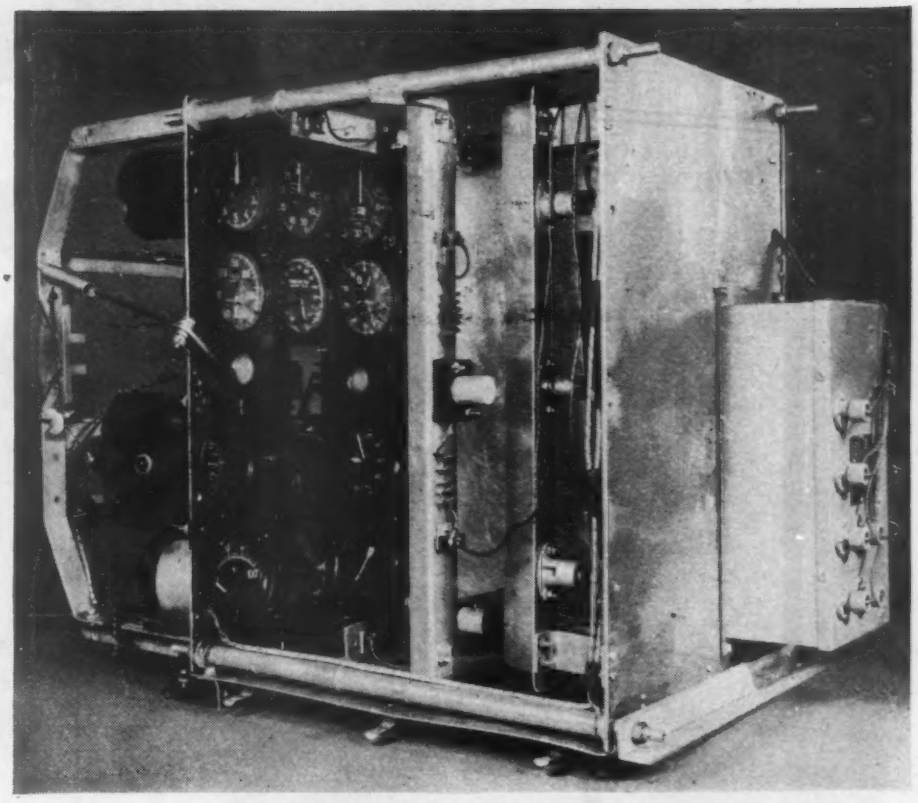
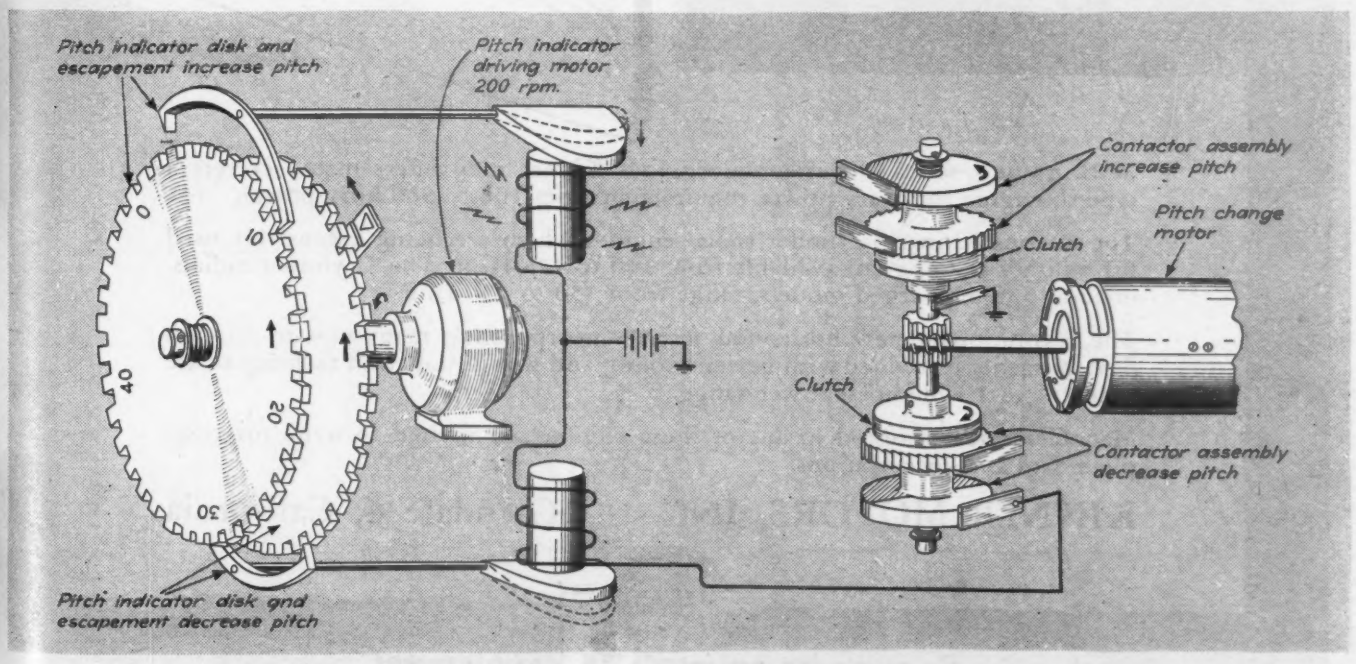


Photo-observer panel used in tests.



Schematic drawing of pitch indicator.

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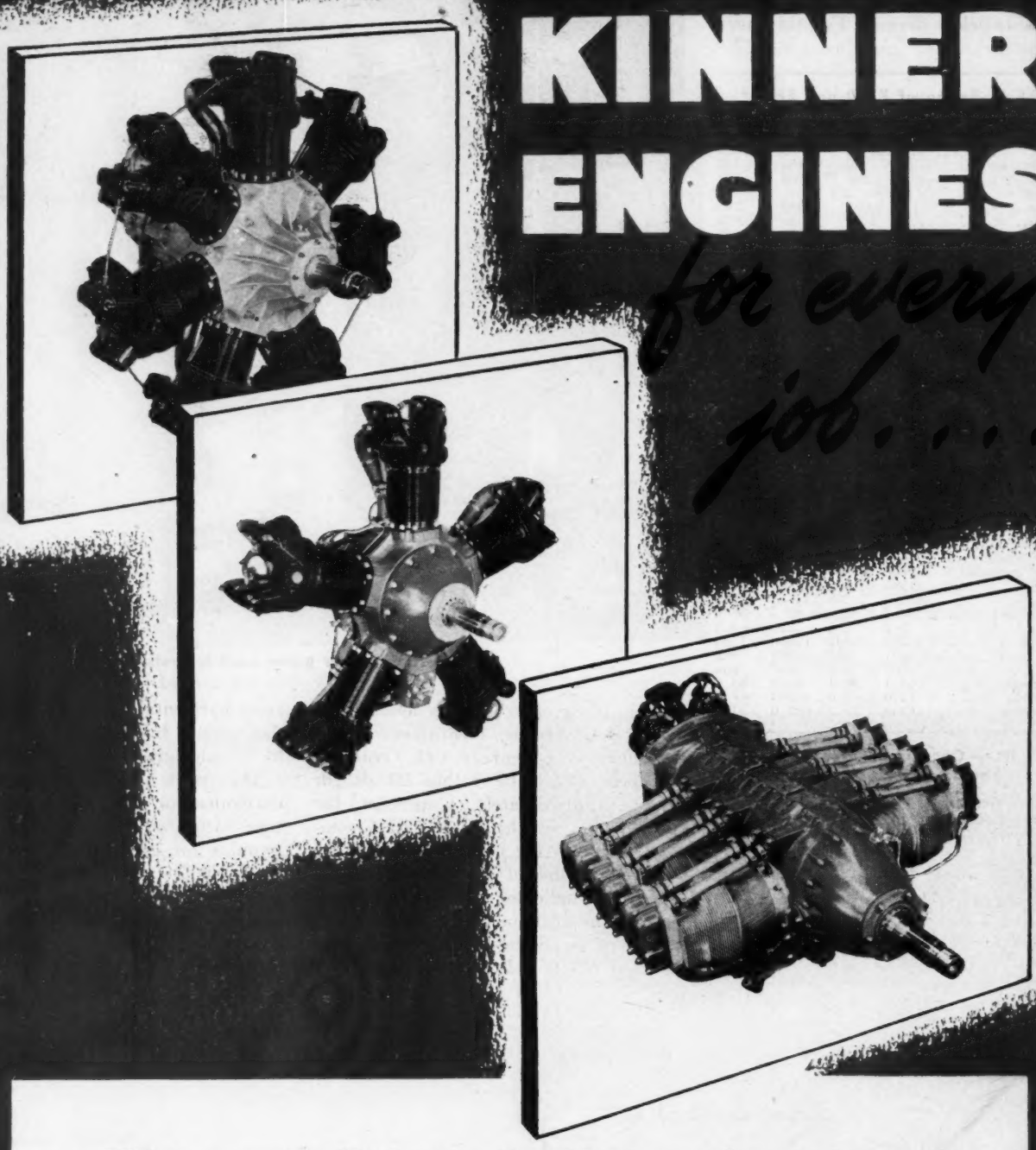

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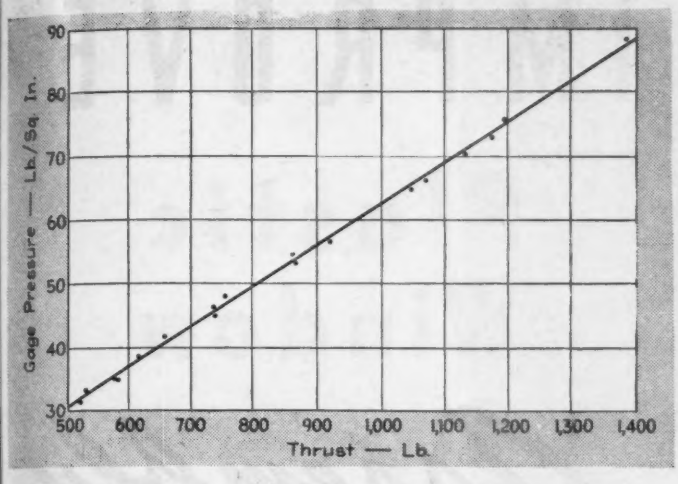
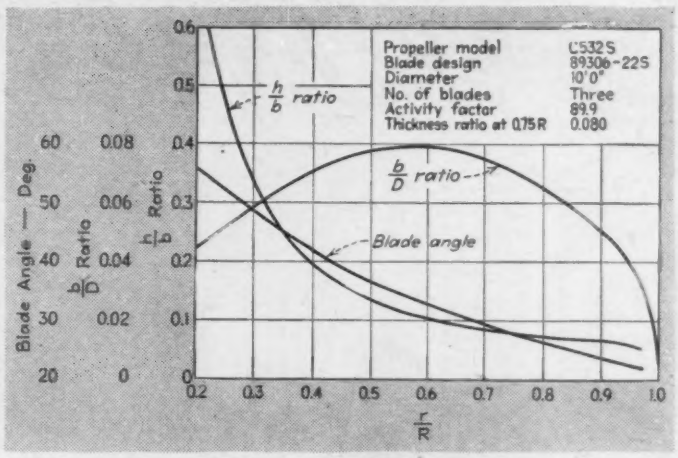


Calibration of thrust meter on airplane with running engine.

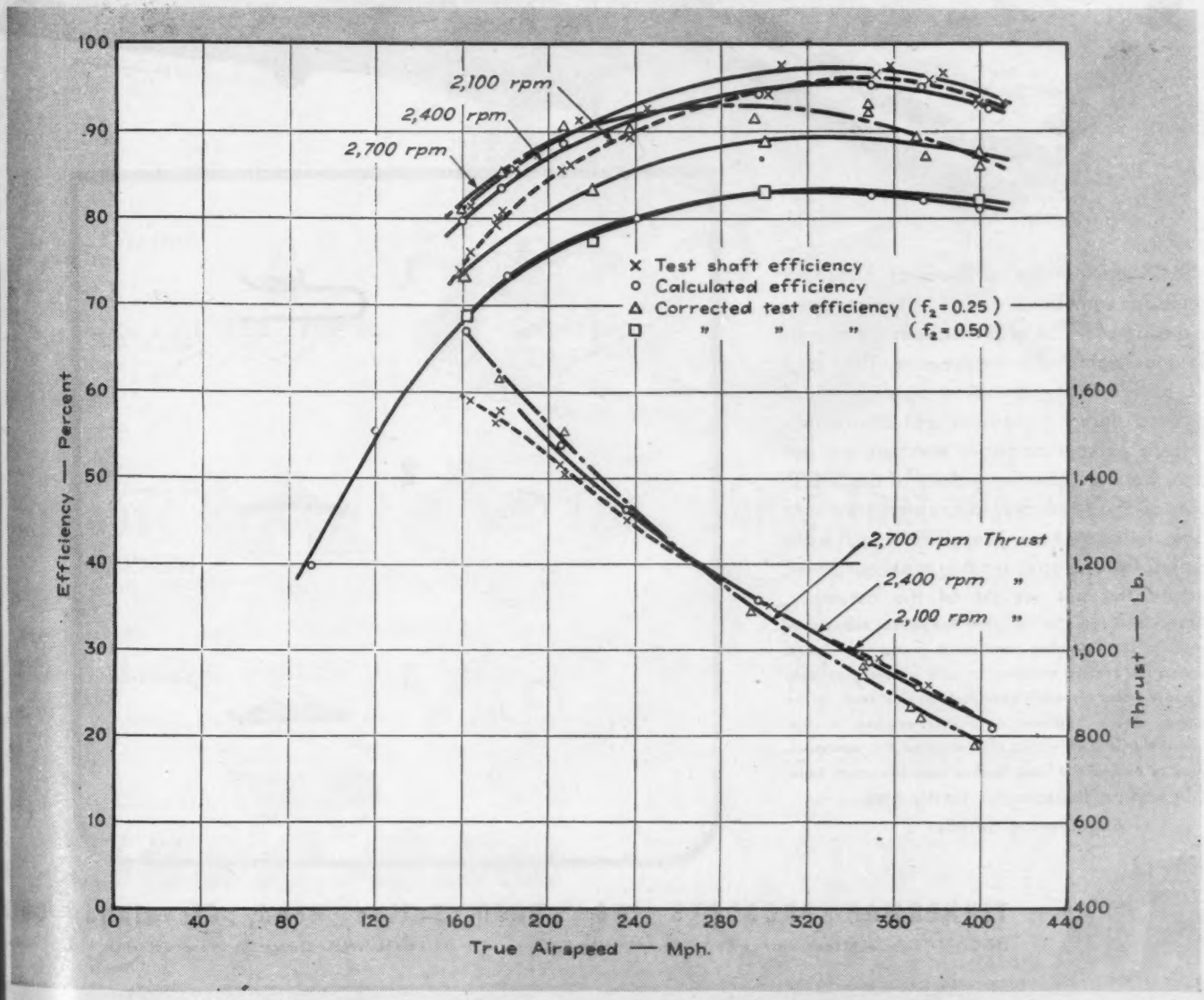


Characteristics of blades used in tests.

In flight the procedure is to adjust power and rpm. to specified conditions after locating desired density altitude. After a steady condition is reached, photo-observer is started and operated automatically for 3 min. Frequency of operation is four frames in 5 sec. Climb tests were made so that specified power and rpm. conditions were reached at specified altitude and airspeed by starting the climb 2,000 ft. below desired altitude and making all adjustments so that desired b.m.e.p. was obtained at specified altitude. Without changing settings, the airplane was climbed to 1,500 ft. above this altitude, with photo-observer operating continuously.

Tests above maximum level flight speed are made by diving. Required

(*Turn to page* 303)



Flight test results: Variation of shaft thrust and efficiency with airspeed. Comparison of propulsive efficiencies determined by test and calculated for 2,400 rpm.

Speed Nuts IMPROVE Plastic Window Assembly

SPEED NUTS answer the problem of attaching plastic windows without danger of fracturing. They provide a spring-tension grip that frees the assembly from dead-tight fastening pressure. They also hold the plastic firmly in locked position under vibration and permit expansion and contraction of the plastic without damage. Washers are not needed as the wide bearing surface of the SPEED NUT spreads the load over a greater area and away from the screw hole. These SPEED NUTS are also applied faster—saving many manhour's time and reduce the net weight of the assembly.

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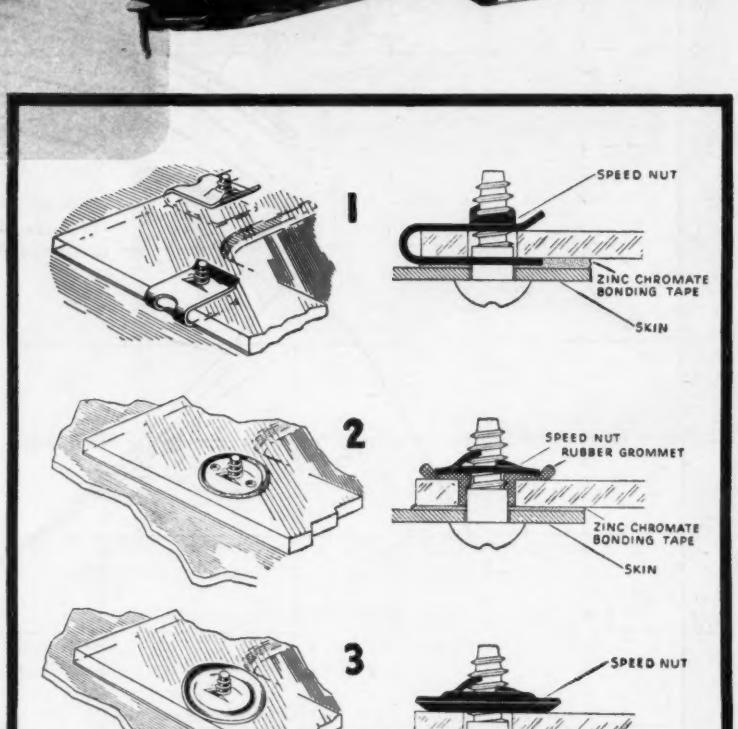
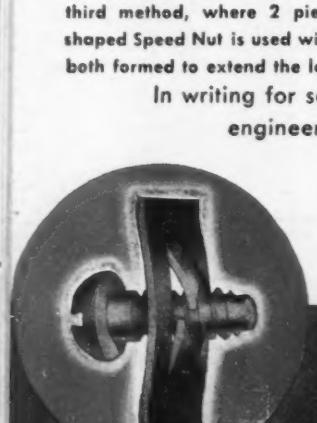
In writing for samples kindly give engineering details.





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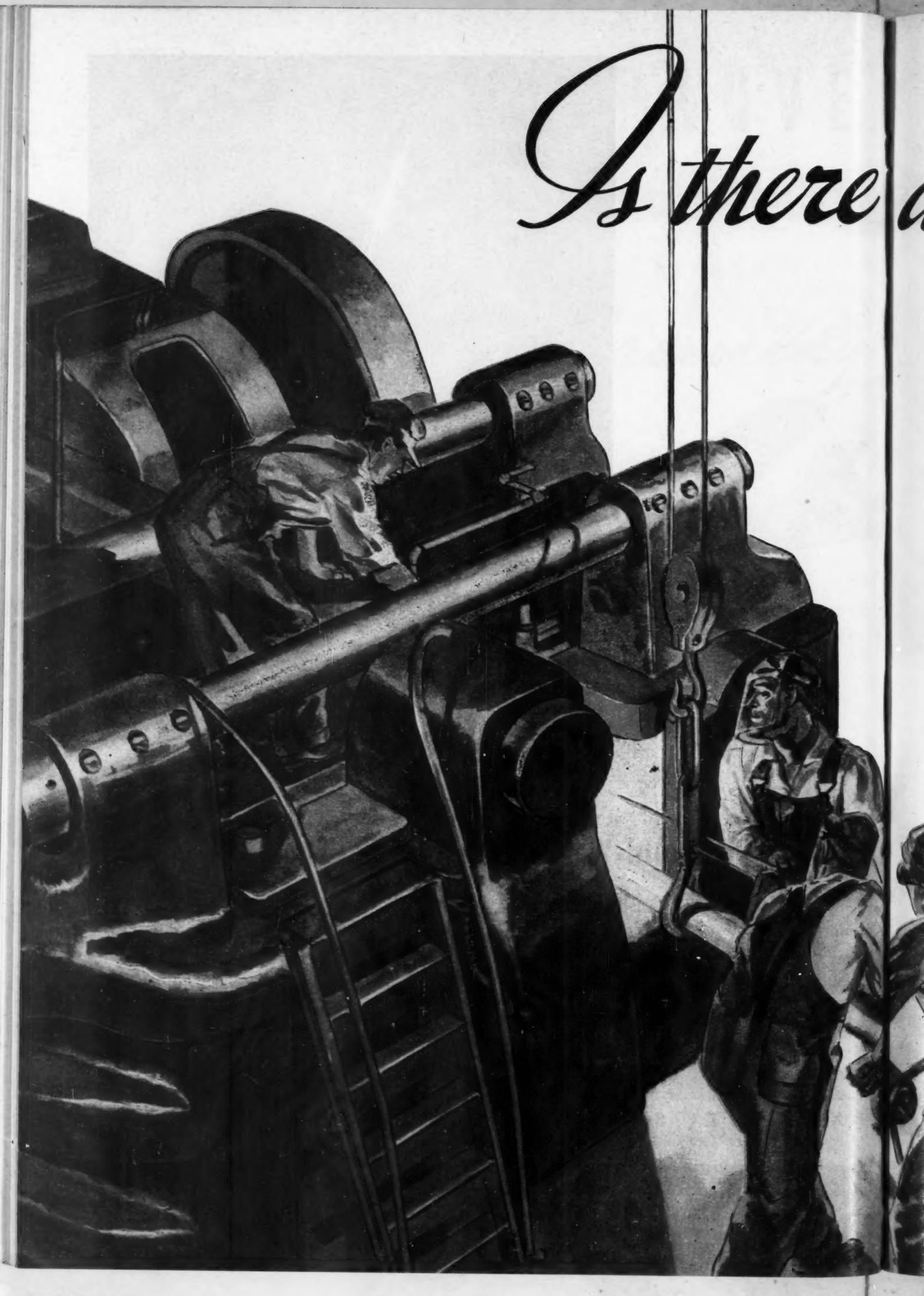
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TODAY scores of the more complicated and exacting parts of war and post-war products are being re-examined for forging possibilities.

Production and military men are asking each other: "Would *forging* improve this part and speed its production?" Both groups frequently ask Tube Turns: "*Can* it be forged?"

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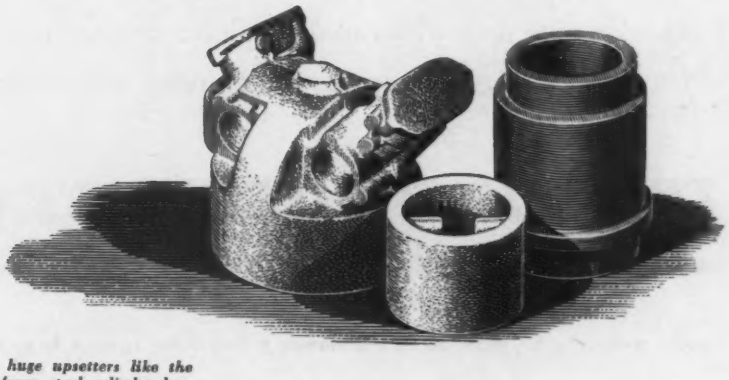
Forgings for Industry



At Tube Turns, huge upsetters like the one at the left forge steel cylinder barrels and aluminum cylinder heads with uncanny speed and accuracy. Aluminum pistons are forged on mechanical presses.

THE GRUMMAN HELLCAT, scrappy Navy fighter, offers a new combination of climb, twist, punch and speed. Photo courtesy Grumman Aircraft Engineering Corporation.

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Flexible Cable Control Eliminates Backlash

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IN AT LEAST ONE PARTICULAR there is a similarity between an aircraft in flight and the human body in motion. Both are intricate mechanisms dependent upon coordinated control of the various members which make up the whole.

If we proceed with this analogy it might be logical to regard the pilot as the brain of the aircraft and the controls as the nerve system. If they are so considered, their importance is emphasized to a degree commensurate with the vital functions which they perform.

Controls have been made the subject of study and engineering development. But although they have been improved considerably, unfortunately they have not yet attained that state of perfection which the aircraft engineer may regard as satisfactory. Indeed, they are one of his most irritating problems and must be classed as a "necessary evil."

Generally speaking the flying controls which operate the elevators, rudder, and ailerons fall into a class which is separate from the controls for power plant and propellers. There are several factors of prime importance which make the problem of the latter an intricate one, and this problem becomes even more complicated when the controls are installed in multi-engined aircraft.

Factors which must be considered in studying the problem of power plant and propeller controls are:

1. *Positive Action.* Operation must be positive and unfailing under all flight conditions irrespective of temperature, icing, vibration, and relative movement of various parts of the airframe throughout which the control operates. This factor becomes more important as higher altitudes (and lower temperatures) are reached and as the flexibility of engine mountings and of the various members of the air frame is increased.

2. *Back Lash.* Lost motion, or backlash, must be negligible, otherwise it is difficult or impossible to obtain precise adjustment by means of the control. This factor, always of importance, becomes more critical in multi-engined aircraft, in which it is necessary to synchronize the speed of two or more engines and the pitch of each propeller.

3. *Flexibility.* The control must be sufficiently flexible to absorb vibration and relative movement between the control and remote ends. If such movement is not absorbed by the control but is transmitted, it will cause involuntary operation of the controlled unit.

4. *Stress Loads.* The control should not transmit stress loads to the airframe. As the necessary number of controls increases, this becomes of greater importance and directly affects design and ultimate weight of the aircraft.

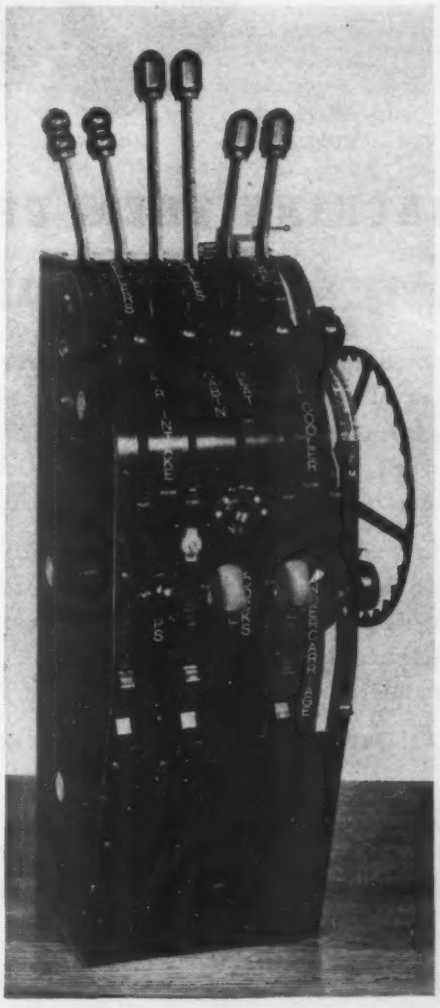
5. *Simplicity.* It is necessary to provide for trouble-free service and long life with a minimum of maintenance. The controls should be of simple design, easily adapted to any application. They should be easy to install and repair without special tools or equipment. The controls should be made up of interchangeable standard parts, otherwise a serious problem of spares arises.

6. *Weight* becomes increasingly important as lower weight-power ratios are sought and as the necessary number of controls increases. The controls should be as light as possible.

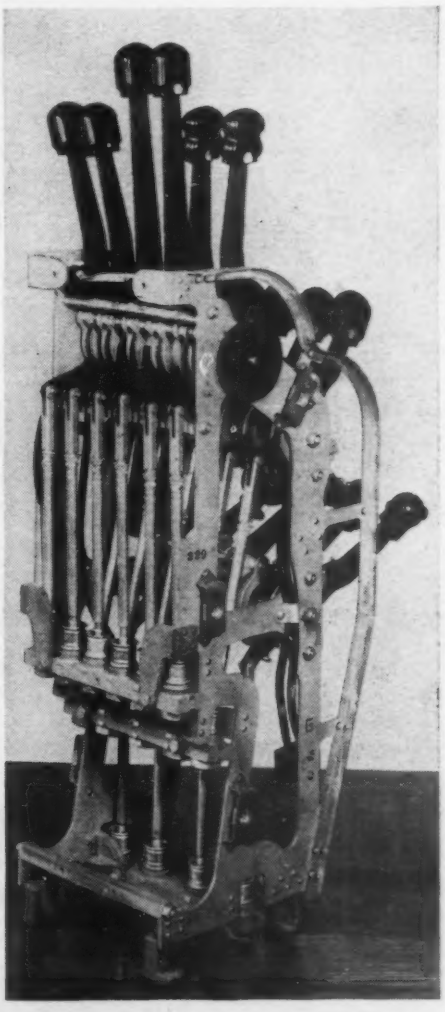
7. *Efficiency.* The control must be efficient. It must operate accurately and satisfactorily in the particular application in which it is used. Efficiency, however, is a relative requirement rather than absolute one, and it differs with each application.

Mechanical controls for power plants and propellers find favor because they are the most positive and dependable. There are three distinct types of mechanical controls, and in some applications different types are combined within one control. Fundamentally, however, each of these types should receive separate consideration in the light of the requirements which have been suggested.

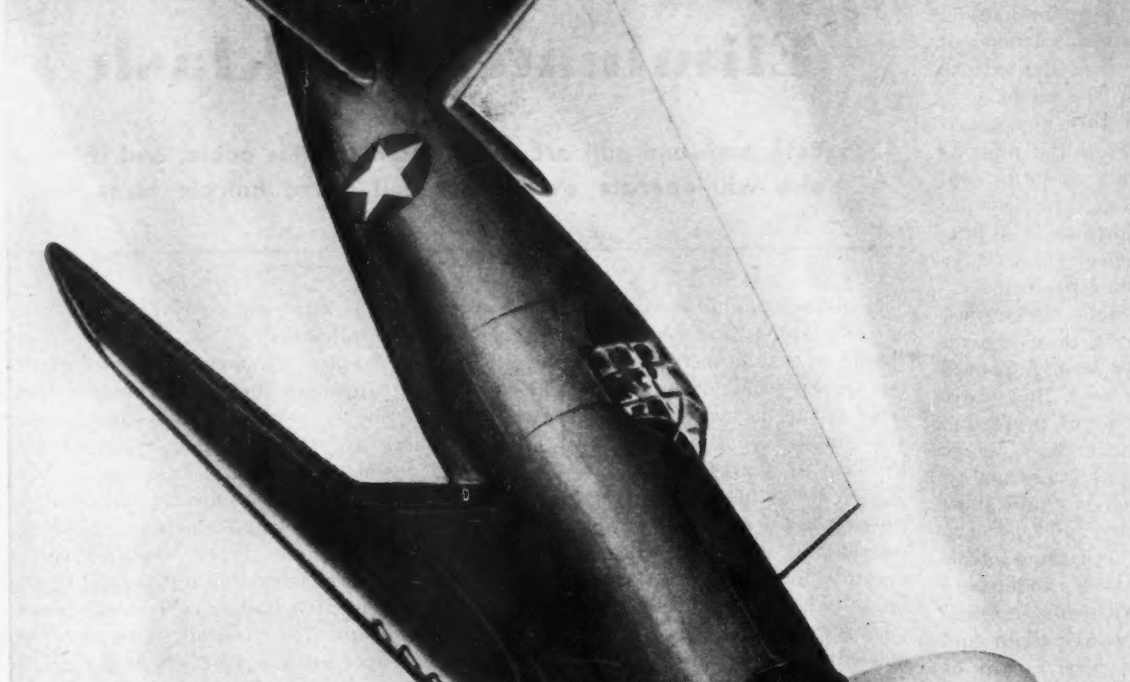
8. *Rigid Rod Controls.* The push rod, in simple applications where the length of the control is short and angular travel is limited to 70 deg., is generally the best control available. It is decidedly



Teleflex centralization of controls operable by either pilot or co-pilot.



Rear view of 16-control unit. It is 22 in. high and takes 8x10 in. floor space.



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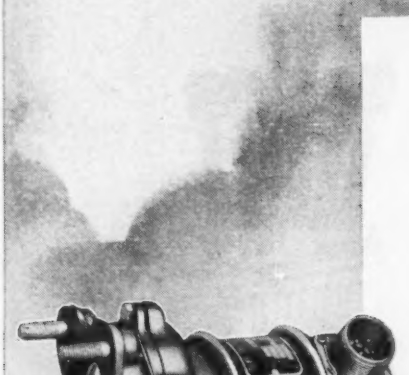

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positive, has no backlash, is exceedingly simple and efficient, and is comparatively light. It is, of course, inflexible and cannot be used satisfactorily if there is substantial relative movement between the control and remote ends. In its most simple form it transmits stress loads to the mountings at the control and remote ends only.

If a rigid rod control must operate through a change of direction of more than a few degrees, it is necessary to introduce a bell crank which must be supported on a pivot, which itself must be supported. The lever of the bell crank is, of course, at its peak operation in only one position, and it is generally conceded that the satisfactory maximum of angular movement is 70 deg. If a control must operate through a total length of 20 ft. and change direction five times, it is necessary to introduce a minimum of five bell cranks, each of which would require three pivoted connections, or a total of 15 in all. Each of such connections detracts from the positive action of the control and permits lost motion, however slight. The very essence of the best features of this type of control depends upon its rigidify, and therefore it is not well adapted to applications in which there is relative movement between the control and remote ends, such as is found in aircraft whose power plants are flexibly mounted or the airframe of which is flexible.

Each bell crank must be supported by the airframe, and the structural member, or members, called upon to furnish this support must therefore withstand, in addition to the load of its primary function, the total load which may be placed upon the control in question. If there are several controls and the load is substantial, this may become an important factor. The control should have a long life and require comparatively little maintenance, but it must be designed to a nicety and therefore presents an engineering problem.

The weight of such a control is excessive. If a straight run is unsupported the rod (or tube) must be substantial and strong or it must be supported to prevent bending. The efficiency is relatively good, but because of the engineering involved and special parts required in a complicated system the cost is high.

9. *Cable Controls.* The conventional cable control consisting of a tension cable in a closed circuit cannot be compared favorably with the push-rod control in the most simple applications, but in those which are more complicated it eliminates some of the objections to the push-rod, while retaining others. Even in long runs containing several changes of direction it is positive when operating under pre-determined tension, free of backlash, and quite efficient (power input-output).

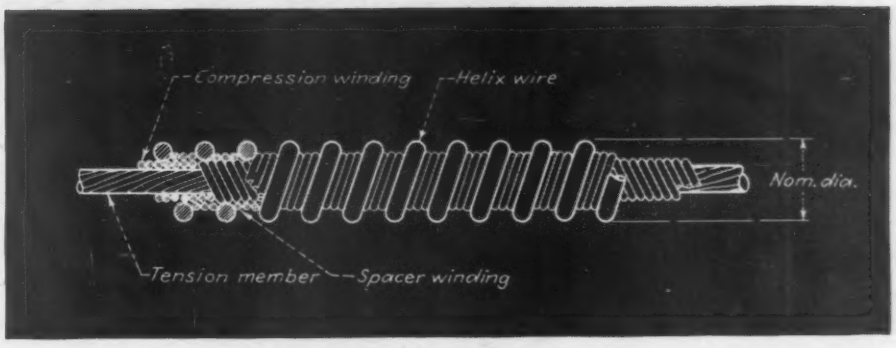


Diagram of Teleflex cable.

Unfortunately its satisfactory operation depends on tension in the control. This changes with temperature. And such a control, which operates very well when tuned in the hangar, may be "heavy" and stiff in operation at high altitudes because of increased tension resulting from contraction of the cable at low temperature. The cable is stretched under such conditions, and the controls become sloppy and loose and subject to backlash at lower altitudes and higher temperatures. Because controls of this type are set up under tension stress, loads upon the airframe result; and since it is necessary to mount two pulleys or blocks at eash point where a change of direction is necessary it is subject to greater objection from the standpoint of stress than a rigid control.

This type of control requires frequent adjustment and continual inspection, but it should have relatively long life. The design presents many problems, and installation is relatively difficult. It is lighter than a push-rod control, but it is quite expensive, not because of the cost of its component parts but because of the designing involved. Perhaps the most serious defect is a tendency for the control to creep. This follows because of unequal tension between the outgoing and return lines. After each movement of the control there will be greater tension on one side of the control than on the other, and when it is subjected to vibration or movement there is a tendency for this to equalize, which moves the controlled unit.

10. *Flexible Mechanical Controls.* In this field there are many ingenious devices which have been more or less highly developed. The basic principle involved, however, is common to all of them, and each consists fundamentally of a tube or conduit through which extends a simple or compound movable element, usually a wire or cable. As a matter of pure theory all such controls are unsatisfactory because backlash is necessarily present and efficiency (input-output) is low because of friction. It is surprising to find on examination that many of these controls are quite satisfactory despite their theoretical limitations. In many cases, backlash has been overcome to such an extent that in this

(*Turn to page* 303)

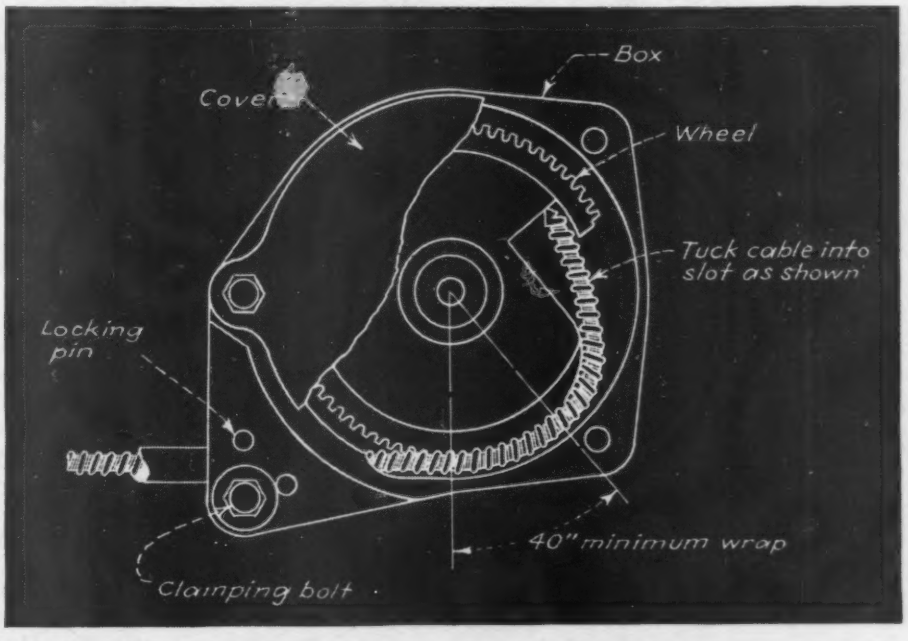


Diagram of box used to convert straight line to rotary motion with Teleflex cable.

Autopilot Gives Instant Control

By EDWARD E. THORP

Demands for greater accuracy in bombing brought development of this device which reacts faster than any pilot. Foreseen, too, is its broad use as a flight-smoother on airliners in the coming peace.

IT REQUIRES a tenth of a second for a normal man to react to an outside stimulus. In that time a bomber flies 50 ft. Thus, when an outside disturbance—wind, rough air, clouds, or enemy gunfire—throws a combat plane off its target, the loss of a second in recovering its position often results in a bomb missing its objective by several hundred feet.

But today, sensitive mechanisms which react faster and operate more accurately than the human system have been installed in bombers to take control when flight accuracy is of the greatest importance.

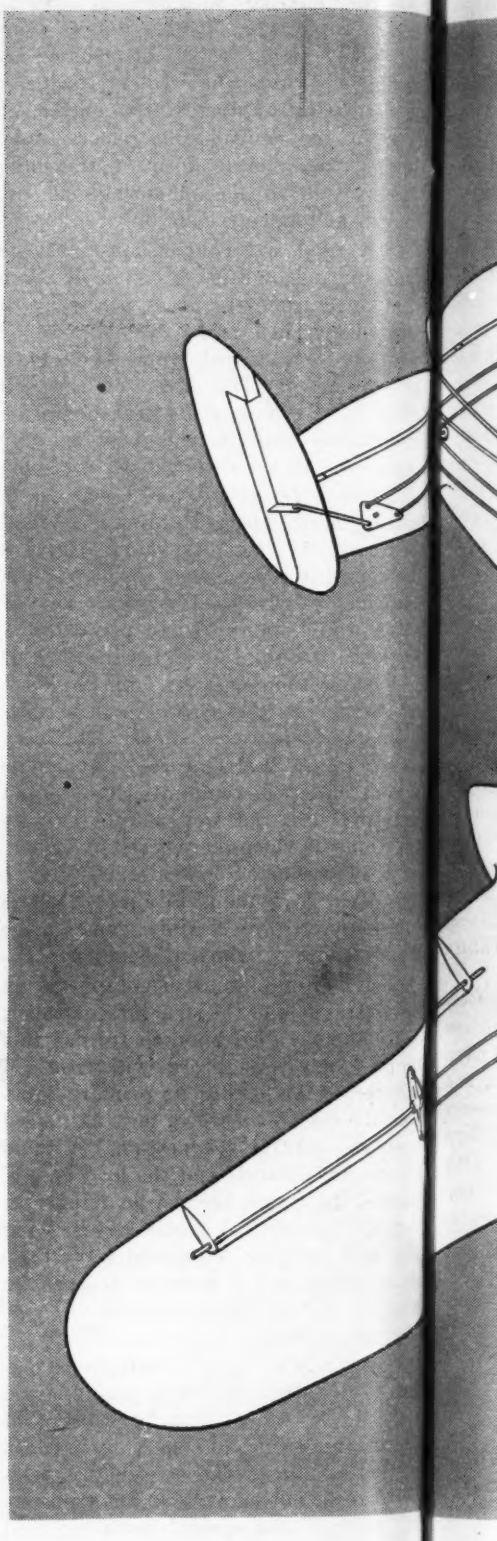
Minneapolis - Honeywell Regulator Co. has designed and is producing for the AAF the Autopilot control which commences to counteract the effects of any deviation from the set course as soon as it is measurable and long before human perceptions could notice that anything was amiss.

The action depends upon two gyro controls, one of which handles the horizontal or directional motion while the other controls vertical movement of the airplane Gyroscopic sensitivity is such that the slightest movement of the airplane causes instantaneous reaction on the controls, with the result that correction commences at the instant of disturbance.

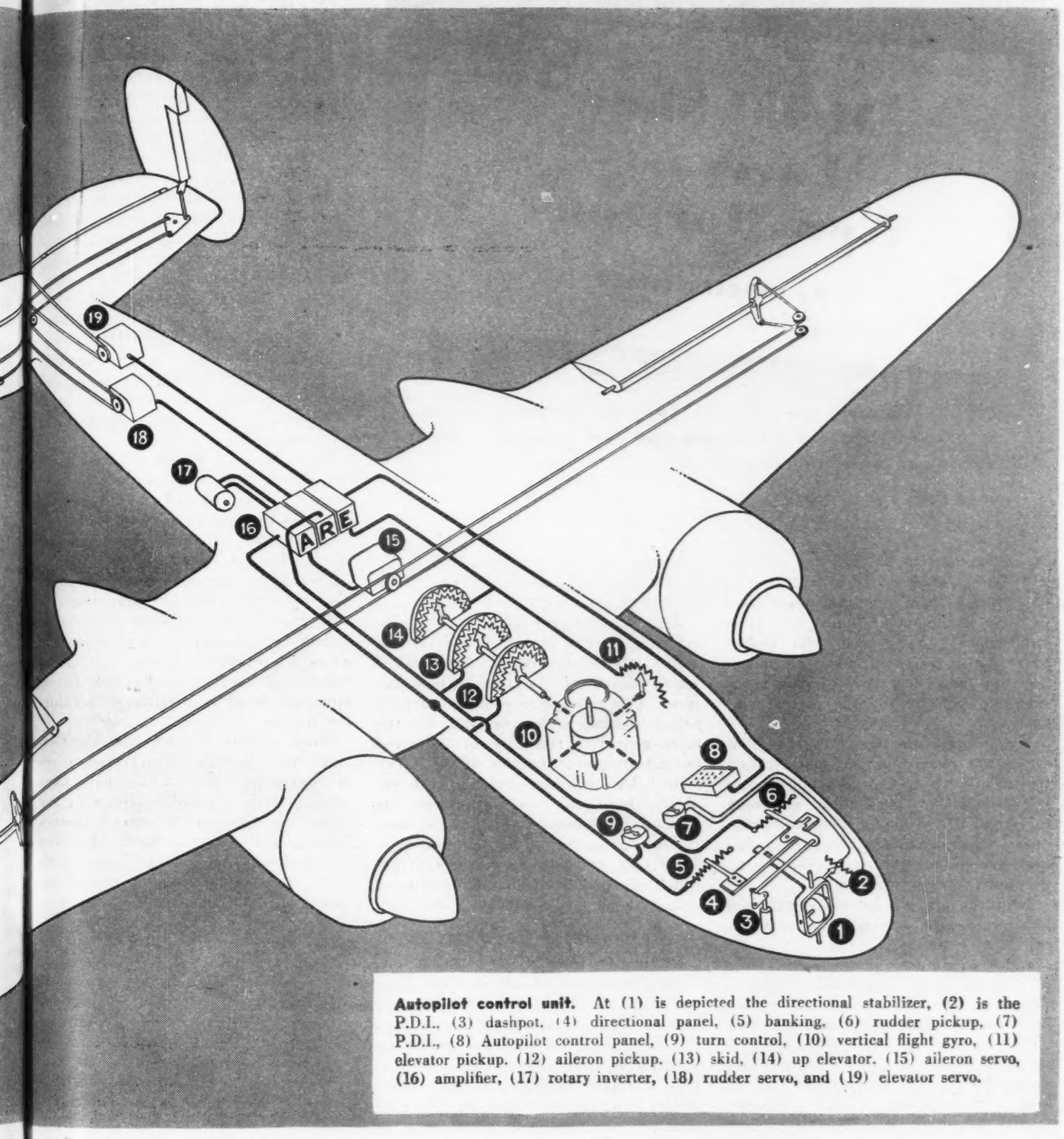
Referring to the accompanying diagram, flight direction is controlled by directional gyro (1) which operates both the P. D. I. (2) and directional panel (4). The directional panel carries two arm wipers, one for banking (5) and the other for rudder (6), latter being pivoted on directional panel (4). The opposite end of rudder pickup (6) is attached by means of a link to dashpot (3), which — within limits — prevents sudden skids from too greatly affecting the plane's position, by accelerating the action of rudder pickup (6) and then gradually permitting its return to normal position.

The turn control (7) regulates the relative motion of rudder and ailerons in banking or turning, but if the pilot wishes to set the controls for banking at a certain angle he sets the large knob on the upper left hand corner of control panel (8). This board has an ingenious combination of lights so interlocked that they flash when any control is not coordinated with the rest but which do not shine if all controls are correct in their relative setting.

Rotary inverter (17) supplies current for operating the system. The servo motors, of which there are three—one each for elevators, rudder, and ailerons—obtain their power from the ship's supply. These motors not only move the control surfaces to positions corresponding to that of the related wiper operated by the gyros, but they also remain locked in position until further impulses are transmitted to them by their electrical controls. Current is amplified by electronic amplifier (16) consisting of three parts, *A* for ailerons, *R* for the rudder, *E* for the elevators.



The servo motors are placed close to the parts they operate, a system which has many advantages. If the airplane is struck by shell fire, there is little likelihood that small, flexible wiring between the amplifier and servo motor would be damaged, whereas mechanical controls from the cockpit to the wings and tail surfaces are always in danger of being severed. In such event the ship can be flown safely home with the Minneapolis-Honeywell electronic Autopilot.



Autopilot control unit. At (1) is depicted the directional stabilizer, (2) is the P.D.I., (3) dashpot, (4) directional panel, (5) banking, (6) rudder pickup, (7) P.D.I., (8) Autopilot control panel, (9) turn control, (10) vertical flight gyro, (11) elevator pickup, (12) aileron pickup, (13) skid, (14) up elevator, (15) aileron servo, (16) amplifier, (17) rotary inverter, (18) rudder servo, and (19) elevator servo.

Tilting of the plane by rough air or shell fire causes gyro (10) to turn on its fore and aft axis, rotating the wiper of aileron control (12), which causes a corresponding change in the position of servo motor (15) and the ailerons it operates, returning the wings to horizontal position. Should the airplane deviate from course because of wings being tilted from horizontal, a corrective signal will be introduced from gyro (1) to return the ship to its set course. Levelling is done by gyro (10) and the various motors it controls. As the plane returns to the course and position it originally occupied, the gyros move back to the relative positions previous to the disturbance, eliminating as they move the correcting control which is now no longer necessary.

If the nose of the plane were to drop, directional flight gyro (10) would commence to act at the same instant as the beginning of deviation from the original line of flight. Consequently, the elevators would be operated to return the airplane to level flight, the entire operation of levelling being continuous and simultaneous with the motion requiring correction.

Because of this feature, not only is the correction made in time to prevent some of the out-of-line motion, thereby restoring the plane to level flight position as soon as possible, but because of the action of the controls taking place simultaneously with the disturbance, there is comparatively little deviation before returning to the line of flight.

Metal Show Forecasts New Horizons

By HERBERT CHASE

Rapidly improving and sometimes radical techniques, coupled with completely new alloys, presage vast changes in both design and production of aircraft.

NO TWO VISITORS to the recent Chicago War Conference Display, and to the meetings held simultaneously, seem to have taken home quite the same impressions. Yet those who looked below the surface saw uncounted indications of new departures having considerable portent for the aircraft industry.

Emphasized was the fact that new alloys are ready for the market, new treatments are being developed, and hundreds of new possibilities are being investigated. Today, all metal producers have augmented capacity, and they are preparing for intensive competition in postwar markets.

Light metals, of special significance to aircraft engineers and manufacturers, are not remaining static. Reynolds Metals Co., for example, displayed samples of two new alloys, one of which is primarily for clad sheet stock and is said to offer important advantages over 24-S, including improved formability in annealed condition and a yield strength nearly 50 percent greater. In its heat-treated form, 68,000 psi. tensile strength, 60,000 psi. yield strength, and 10 percent elongation are typical. The second alloy, suited for forging and extrusion, has still higher strength. Neither alloy had been approved for general use by Army or Navy at the time of display, but this approval is anticipated.

The Aluminum Co. announced no new alloys, but it is understood to have some available. These include some having zinc content—already in the hands of certain fabricators—and one alloy, at least, suitable for forging. Data on these were not offered for publication, but some important physicals are said to be superior to those attained in the conventional high strength aluminum alloys, though fabrication is said to be somewhat less favorable.

Aluminum casting alloys are receiving their share of attention, and there is active interest in the use of castings where they have not been favored before. This is made possible in part by better casting technique and by the more general availability of improved testing equipment, notably of the X-ray type. Die castings which, until recently, have not been approved for structural application can now be used in some cases for structural uses, provided they are made in certified plants using approved methods and equipment and manned by competent personnel.

New High-Silicon Alloys

WPB committee studying die castings (which it prefers to call pressure mold castings) is working with new alloys high in silicon, containing some magnesium and understood to have properties superior to other alloys in common use. Cold chamber machines having a controlled injection rate are employed for making the approved pressure mold castings. The product is one in which low cost is subordinate to quality, but it still takes advantage of the economy of die casting.

Only one producer of primary magnesium, the American Magnesium Corp., had space in the exhibit without offering new products, but L. B. Grant of Dow Chemical Co. spoke in behalf of magnesium at one engineering session. His remarks made it clear that the preponderant use is still in the form of castings produced chiefly in sand molds. There are now upward of 100 fabricators, chiefly of castings, but some sheet is being converted into aircraft parts, such as seats and ammunition boxes, and forging facilities are being extended.

The government is advocating wider use of magnesium and, as is well known, has a large stake in its production. So large a stockpile is anticipated that the present prediction is for little production for several years after the war unless stocks are frozen or kept off the market. At present there is a definite effort to increase the use of magnesium forgings by substituting them for aluminum forgings, especially for aircraft use. One prominent aircraft company, for example, is reported converting some 250 aluminum forgings to M-alloy magnesium forgings, but this firm has experienced difficulty in finding producers with both equipment and experience to produce the forgings, even though facilities are being expanded for the purpose.

Revere Copper & Brass Corp., which has recently built a rolling mill for producing magnesium alloy sheet stock, indicates that its capacity is double the total already existing for magnesium sheet. The same company is also preparing to produce magnesium forgings. This departure of a company formerly dealing chiefly in copper-base alloys, to include production of magnesium in wrought forms, indicates a healthy interest in magnesium as well as an apparent belief in a broadening future for its use.

Some reports indicate that the Germans have learned to make better use of magnesium alloys than have been made to date in Allied countries. If and when the German technique becomes known, or a similar or better technique is developed here, there seems little doubt that wider use of magnesium alloys will take place where the economics of their use (including the benefits of light weight) are well founded.

Ampco Metals had a good display of its aluminum bronze products made in quantity by centrifugal casting for the aircraft industry, though these are not new. Most producers of brass, bronze, and copper products appear to have concentrated chiefly on production problems. If they have new developments of significance to the aircraft industry, especially for postwar use, these escaped the writer's notice.

Much the same can be said of zinc-bearing alloys other than brass. The chief ones are for die castings and for sand-cast dies used to shape sheet metal parts. None of these are new, but their utility has been well established. The New Jersey Zinc Co.'s exhibit centered around die castings and included an excellent film on the die casting process in a portion of which the Link trainer was featured.

Of course, zinc alloys are used chiefly

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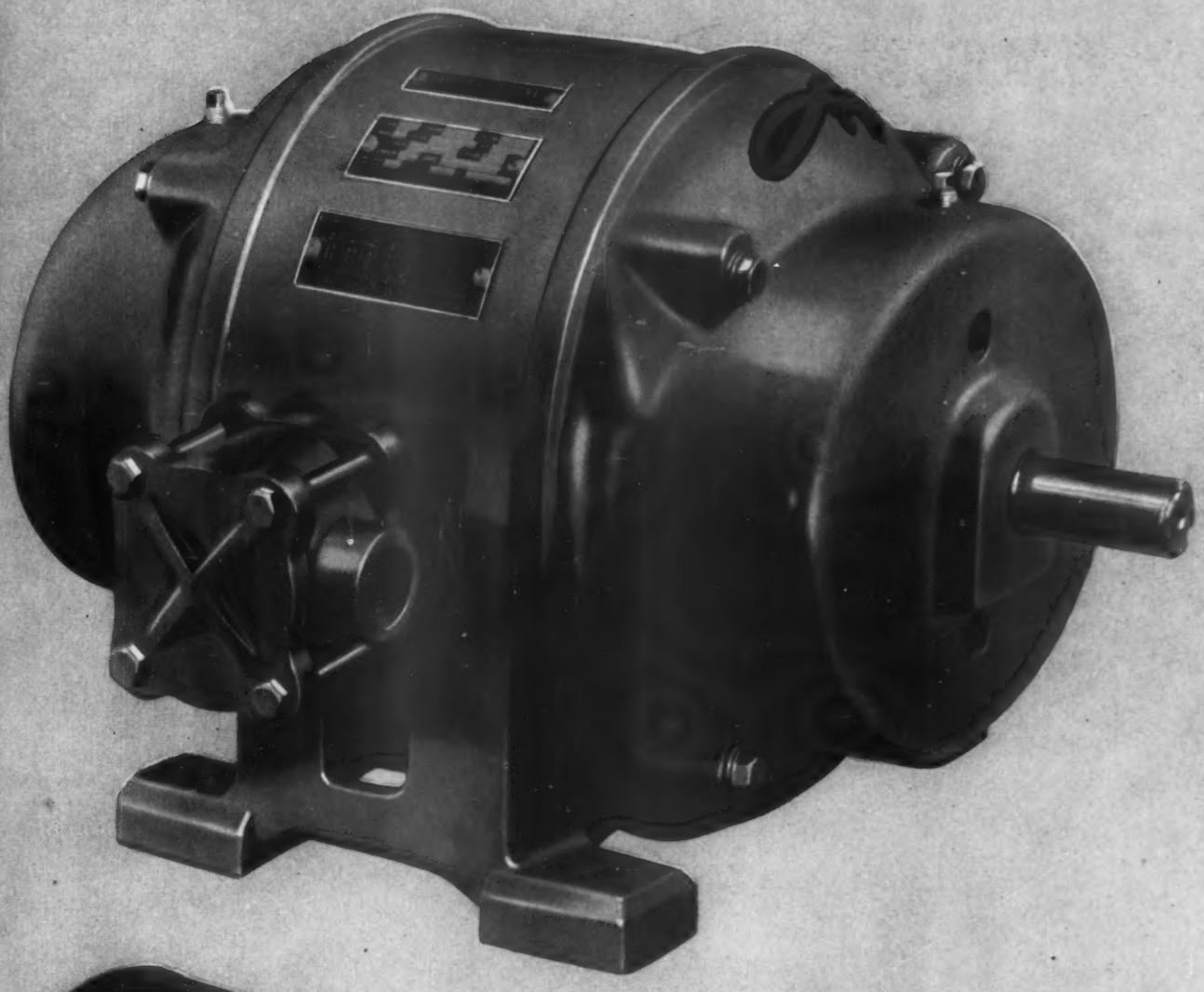

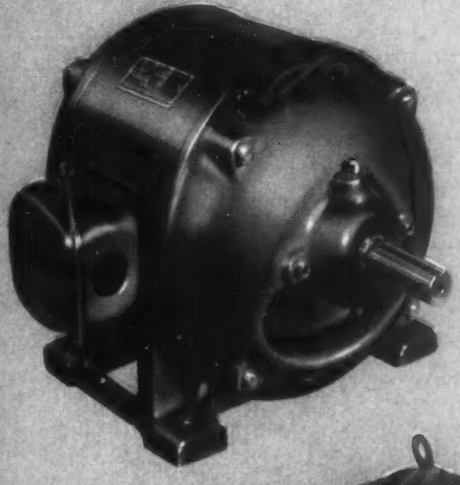

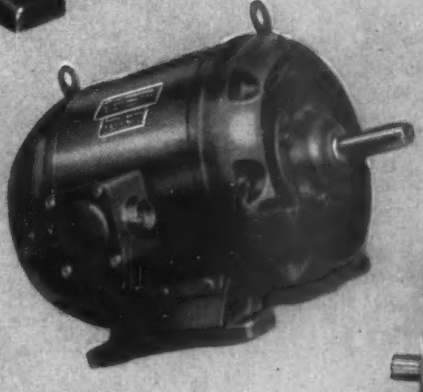

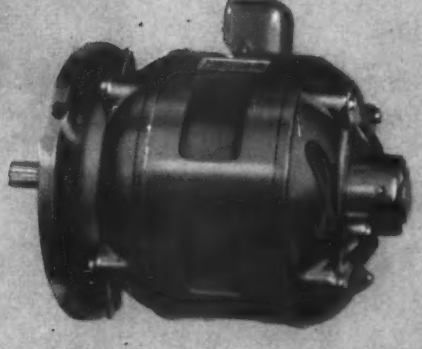

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THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.

Speaking of Electric Motors—

The day of trying to use a standard motor for a special job is about over.

Machinery designers, and production managers have learned that it is much more efficient and economical to obtain a motor with exactly the electrical and mechanical characteristics required to perform a specific job than it is to try to doctor up a standard "shelf" motor to do the job.

Speed and horsepower are no longer the major measuring stick of motor requirements — they are merely incidental to the many other characteristics available in electric motors today.

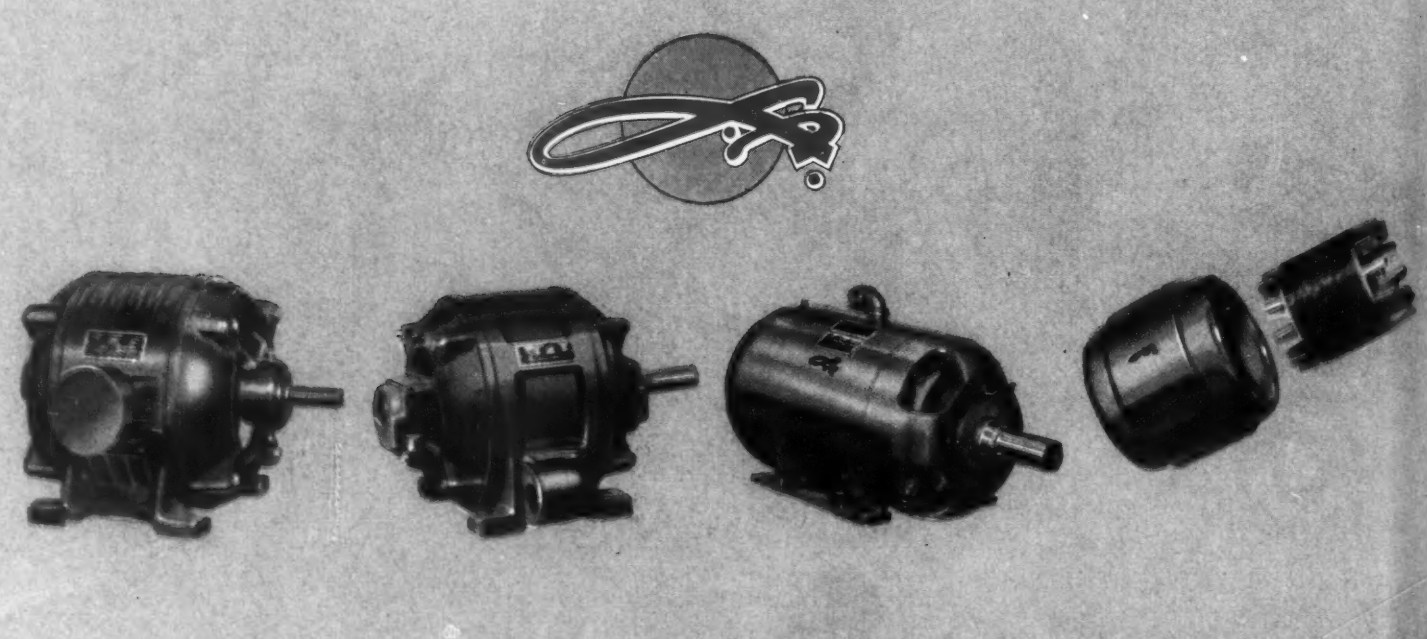
For over forty years we have been developing special motors for special jobs — our engineering department has a wealth of experience along this line —

Right now special Louis Allis motors are serving a major important role in helping your boy and mine win this war — to help bring him back home — safely — and as quickly as possible.

As soon as Uncle Sam does not so urgently need all of our facilities — your electric motor problems and requirements will receive our most prompt and careful attention in every way.

But right now — let's WIN this war!

THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.



Conflicting Reports Confuse Aviation Investors

By H. L. FEDERMAN

Consistent selling of aircrafts and the meager, scattered support of airlines present curious anomaly in "war baby" stock sphere.

WITH THE MARKET definitely peace-conscious despite repeated warnings by military leaders, investors are having a severe case of the jitters. When this happens, it is natural to anticipate renewed selling in the aircrafts—an industry indelibly labeled as a "war baby" in the public mind. Heavy selling did hit the airplane manufacturing shares. But there was also considerable liquidation of airline shares, a "peace" group if there ever was one.

Declines were rather uniformly distributed among the two aviation groups for the week which culminated with the day of the market's sharpest break of the year, Nov. 8. For example, losses registered since Oct. 30 and through Nov. 8 were as follows: Douglas $13.50, American Airlines $5, Boeing $1.62, Eastern $2.50, United Aircraft $2.75, and United Air Lines $4.12. These declines are in terms of dollars per share; percentage-wise they are even more significant.

This anomaly, on the surface, appears confusing. Close analysis, however, can dispel the seemingly contradictory trends.

At present, emotion dominates the market. This will most likely continue over the immediate term. Attention will be largely directed towards war bulletins and possible peace feelers. For the time being, underlying economic conditions, financial factors, and earnings of aviation companies may be expected to receive scant attention by the majority of investors.

A far broader view as to what war has meant to aviation equities and how these shares have reacted with the first tangible straw of victory, is vividly shown by analysis of stock group movements, as revealed by the market record from Pearl Harbor to late Oct. 1943. It shows that, from the very beginning, investors resolutely turned their backs on the aircrafts, with the result that the group, with a drop of about 18 percent, experienced the greatest decline among all other securities in the marketplace. Airline shares, on the other hand, were among the leading beneficiaries, gaining about 41 percent.

Surprisingly enough, while the aircraft industry pioneered and developed the weapon that is proving to be the decisive factor in winning the war, the material gains have gone to other industrial groups participating in the airplane building program. For instance, the automobile shares rose more than 60 percent after Dec. 7, 1941. And the rubber equities skyrocketed more than 100 percent during the same period. As the market reflects profitability and future trend possibilities, these movements show how little the airplane group has directly benefited from war.

When Mussolini was kicked out on July 25, the market was jolted into thinking of an early peace and has never been the same since. The aircrafts declined but not as much as the air transports. Why? Simply because the former had taken their beating for more than a year and a half and ample discounting of the future had taken place. The airlines, however, showed increasing evidence of outdistancing their future prospects, and realization is rapidly spreading that the group will not be without its problems in the postwar world.

It is also an interesting observation that not one of the 30 stock groups in the entire Barron's averages showed any price appreciation since July. Can peace be bad for American industry? Not at all. The conclusion of hostilities means the coming of many problems and unknowns: Reconversion, adaptation to changed conditions, and many attendant uncertainties. It is during such periods that investors tend to become cautious and are inclined to take careful look-sees. As a result, the market follows a nervous course until such time as clear-cut trends again become discernible.

Investment trusts were, at one time, favorably disposed toward certain aviation securities and were a source of considerable market support. For more than a year, however, fund managers have been liquidating these equities (as shown in Wanted: A Haven for Aviation Securities, p. 183 Sept. AVIATION). As a result, instead of being a sustaining influence, trust funds have added their weight to the downward pressure on aviation prices as they continue to move away from these issues. This is again substantiated by an examination of investment portfolios as of Sept. 30, 1943. This time 30 general trusts are examined, providing a substantial coverage of the field and representing one

(*Turn to page* 335)

TABLE I—COMBINED AVIATION HOLDINGS

(30 Major Investment Trusts As of Sept. 30, 1943)

Air Transport	No. of Trusts Holding	Total Shares Held
American	9	20,400
Eastern	7	21,300
Northwest	1	16,000
Pan American	12	122,800
Penn-Central	2	3,400
TWA	1	3,500
United	9	72,000
Aircraft Manufacturers		
Aviation Corp	2	43,275
Bendix	3	31,500
Curtiss-Wright "A"	2	30,300
Lockheed	2	2,000
Martin	1	1,000
North American	1	24,000
Sperry	3	5,000
United Aircraft	4	17,900

TABLE II—NATIONAL AVIATION CORP.

(Aviation Portfolio Changes Dec. 31, 1942—Sept. 30, 1943)

Air Transport	Total Shares Held Dec. 31, 1942	Total Shares Held Sept. 30, 1943	Shares Sold
American	2,800	1,700	1,100
Braniff	a19,500	12,200	7,300
Chicago & Southern b	15,450	10,450	5,000
Eastern	5,800	4,500	1,300
Mid-Continent	17,000	17,000	none
Northwest	15,000	11,500	3,500
Pan American	10,000	7,500	2,500
Penn-Central	17,300	10,800	6,500
Penn-Central, pfd	4,200	3,600	600
TWA	9,000	5,600	3,400
United	14,000	8,300	5,700
Aircraft Manufacturers			
Bell	29,500	22,700	6,800
Bendix	5,000	5,000	none
Boeing	17,500	16,600	900
Cessna	6,000	none	6,000
Curtiss-Wright	25,000	none	25,000
Curtiss-Wright "A"	20,000	20,000	none
Douglas	7,000	7,900	c900
Grumman	10,000	2,900	7,100
Lockheed	20,000	19,400	600
United Aircraft	18,500	17,500	1,000
United Aircraft, pfd	1,600	2,100	c500
Thompson Products	5,000	5,000	none
Continental Av. & Eng.	20,000	none	20,000

Note: Not shown above are holdings in Consolidated Vultee. The merger early this year tends to distort any comparison. As of Sept. 30, 1943, 17,100 shares of common and 10,000 preferred were owned. On Dec. 31, 1942, 19,200 shares of Consolidated and 4,000 shares common and 1,400 preferred of Vultee were owned.

a Braniff holdings adjusted for 50 percent stock dividend.

b Chicago & Southern common and voting trust certificates combined.

c Shares purchased.

TABLE III—BARRON'S STOCK AVERAGES

	Aircraft Manufacturing	Air Transport	50 Stocks
Nov. 4, 1943	*27.80	34.91	78
Oct. 28, 1943	28.82	37.38	80
Oct. 21, 1943	29.08	35.56	80
Oct. 14, 1943	28.35	35.50	79
Oct. 7, 1943	28.40	34.38	78
Nov. 6, 1942	30.90	25.09	67

* New low for year.

"DO THOSE JAPS *Get Burned Up!*"

"They throw everything they have at us, and our planes don't fall apart—it sure burns them up!"

From all over the world comes reports like the above telling of the remarkable stability and toughness of American planes. In spite of everything the enemy can do, a surprising number of them go right on to complete their missions . . . and then come back after having absorbed murderous punishment.

American planes can take it as well as dish it out. That means that every part and all accessory equipment must have extra durability, reliability and stamina. We are proud of the fact that Vickers Hydraulic Equipment is used on a majority of American combat planes.

VICKERS *Incorporated*

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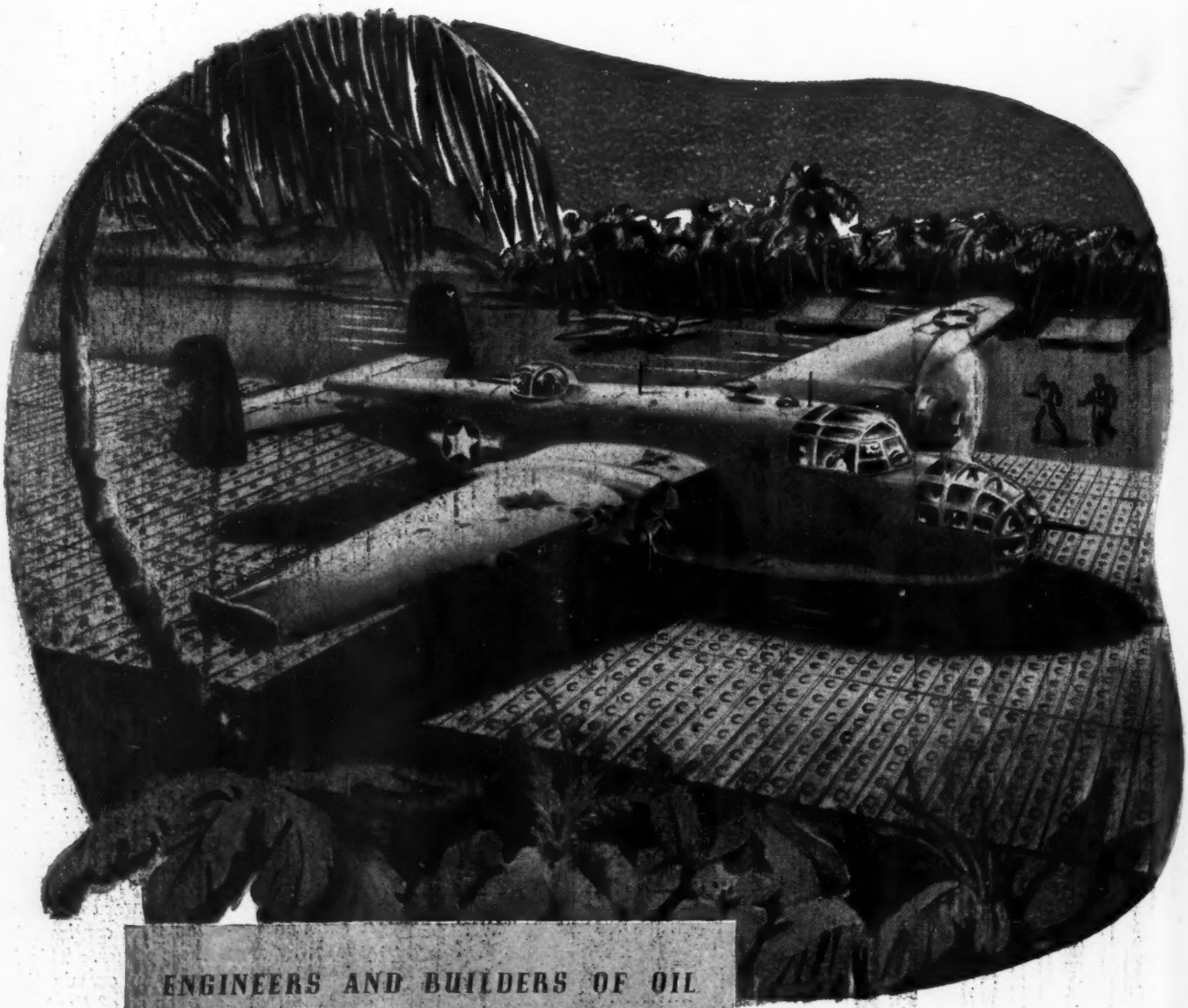
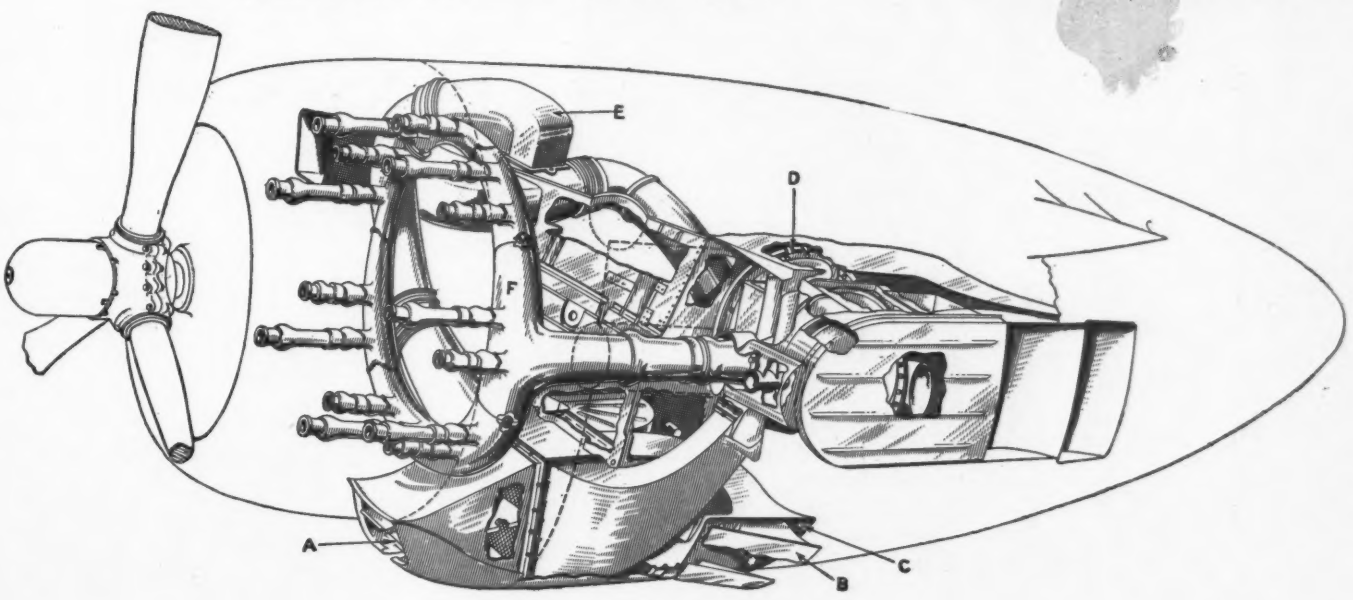
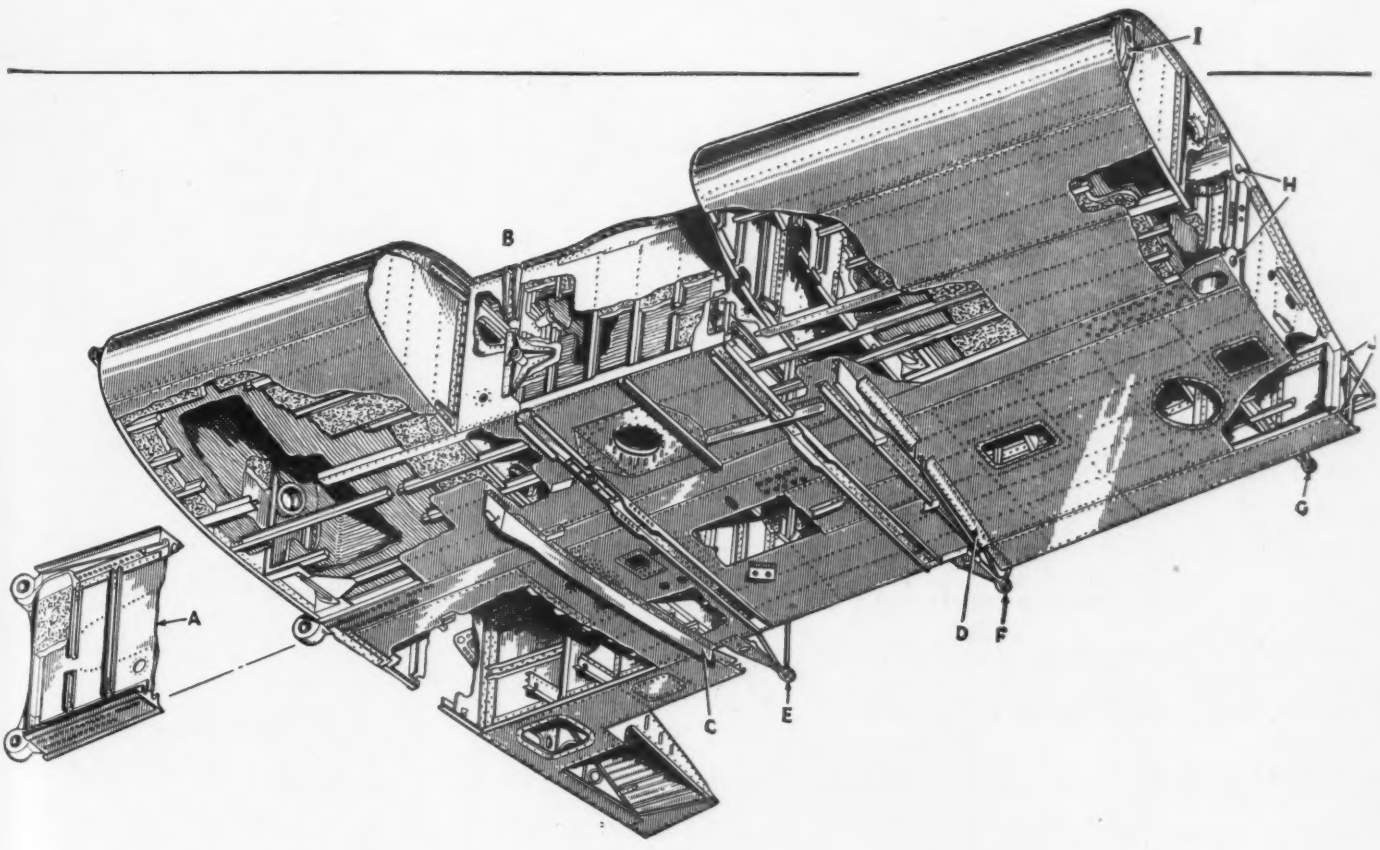


ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

SKETCH BOOK OF DESIGN DETAIL

Phantom view showing turbo supercharger installation in Douglas A-20. Intercooler entrance is at *A*; intercooler door assembly at *B* for exhaust at *C*. Supercharger itself is at *D*, with power plant air induction system installation at *E* and exhaust collector ring at *F*.





Cut-away view shows details of Douglas A-20 inner wing panel construction, with inboard attachment fittings in separate detail sketch at *A*. Cutback portion of wing leading edge at *B* is to accommodate engine nacelle, with strips *C* and *D* forming top of engine nacelle fairing. Flap hinge brackets are shown at *E*, *F* and *G*. Tension bolt fittings for outer wing panel at main spar are at *H*, with leading edge shear web connection at *I* and rear shear web connection at *J*. Note extensive use of access holes.

MAKE THEM MORE AND MORE AUTOMATIC
★★★ TO INCREASE THEIR FIGHTING POWER ★★★★
Like simple subtraction, the fewer controls a pilot must watch, the more attention he can give to his primary job!
White-Rodgers now offers entirely new developments in automatic temperature modulation equipment for the control of:
1. Engine cowl flaps (both air and liquid cooled).
2. Oil cooler shutters or flaps.
3. Cabin temperature (both supercharged and normal).
4. Carburetor air temperature.
Your request for information on controls for the above applications will receive the prompt cooperation of an experienced White-Rodgers Engineer.
WHITE-RODGERS ELECTRIC COMPANY
SAINT LOUIS, MISSOURI
Official Photo Courtesy U. S. Army Air Forces

LET'S GO! U.S.A. KEEP 'EM FLYING!

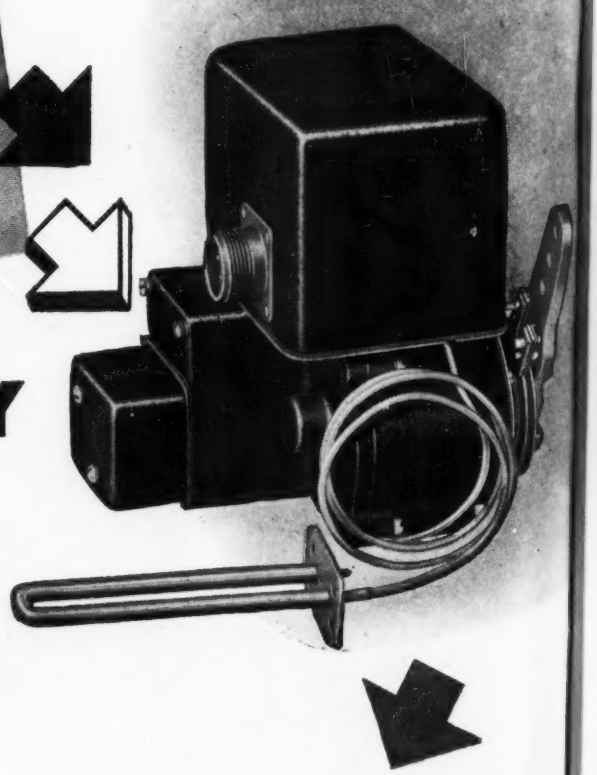
SENTINELS OF SAFETY

PROTECT PLANE AND CREW

White-Rodgers motorized temperature controls automatically prevent excessively high or low temperature conditions that spell danger to a plane and its busy crew.

Equipped with sensitive element applicable to air duct or liquid immersion, length of capillary and the White-Rodgers motor assembly can be varied in design to fit specific applications.

Engineering data will be furnished to manufacturers upon request.

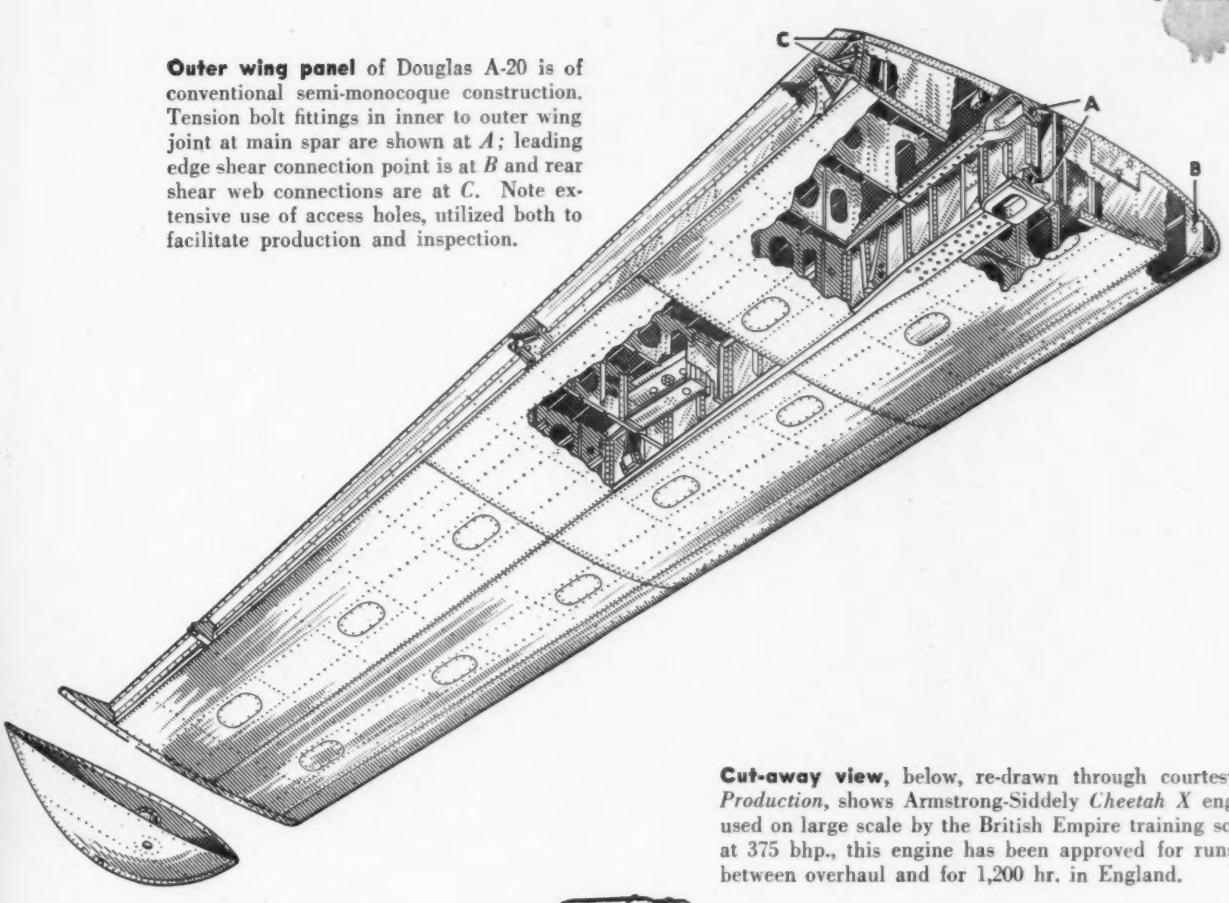


One of the many types of automatic safety controls manufactured for the constantly increasing demands of our armed forces.

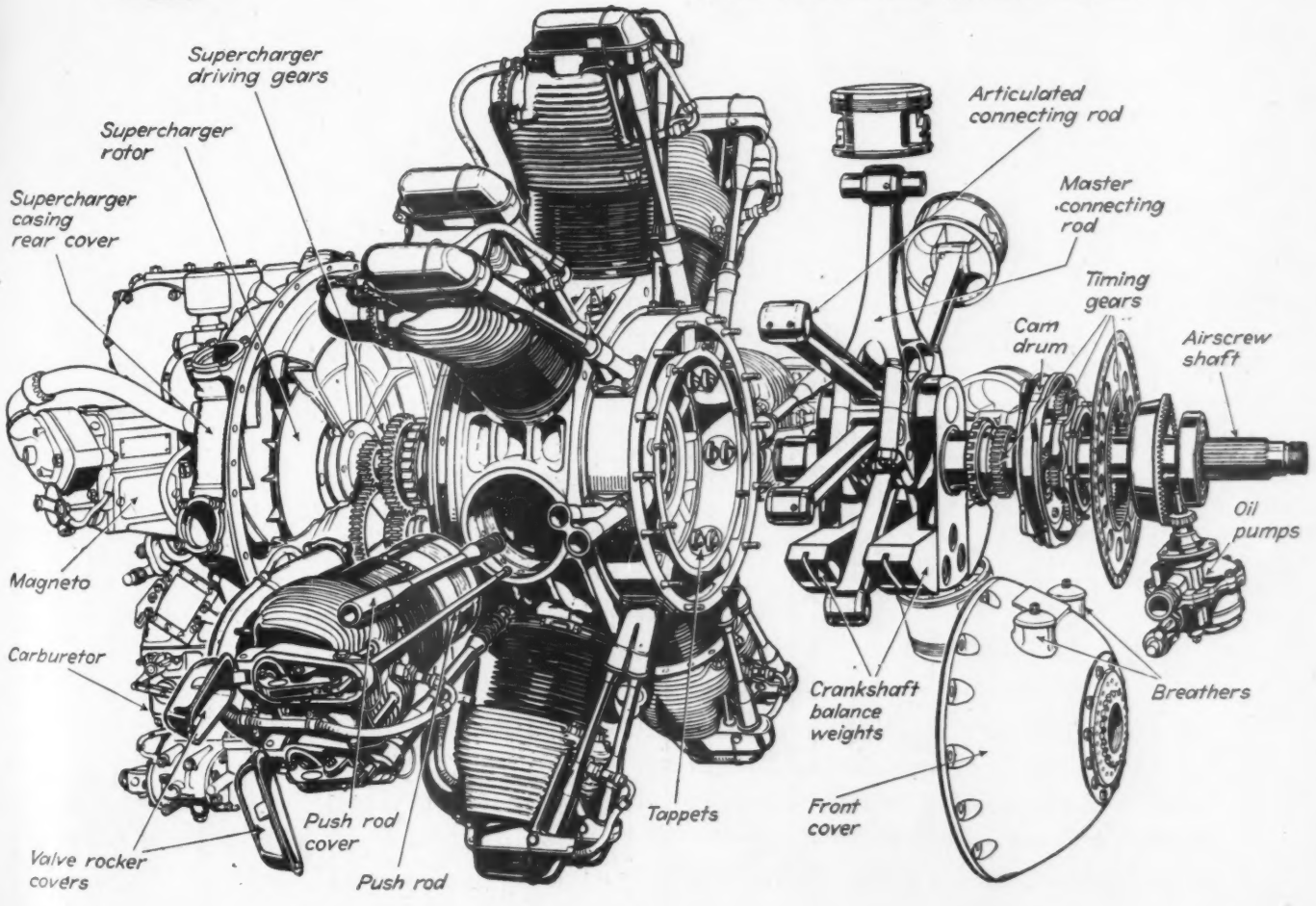
WHITE-RODGERS ELECTRIC CO.

SAINT LOUIS, MO.

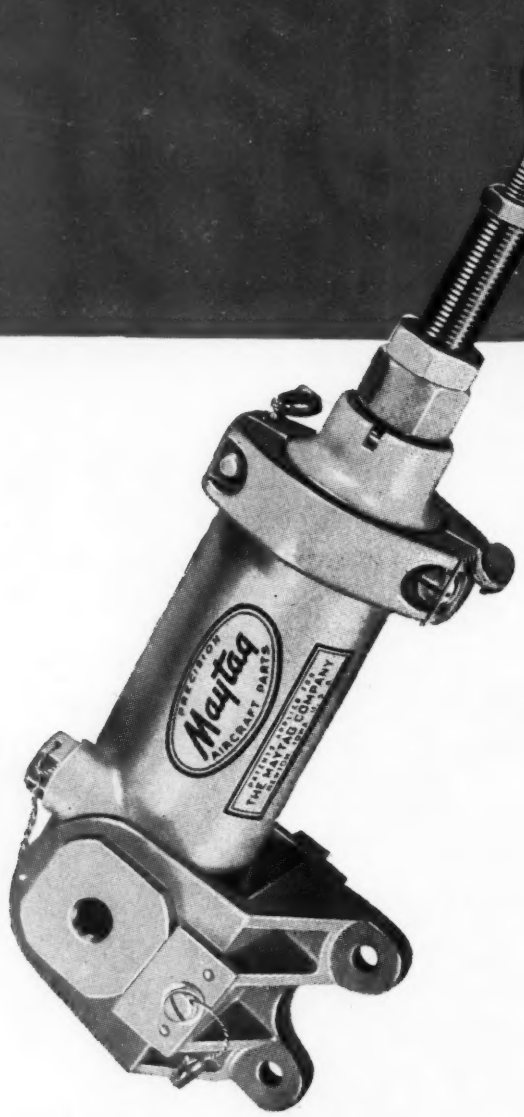
Outer wing panel of Douglas A-20 is of conventional semi-monocoque construction. Tension bolt fittings in inner to outer wing joint at main spar are shown at *A;* leading edge shear connection point is at *B* and rear shear web connections are at *C*. Note extensive use of access holes, utilized both to facilitate production and inspection.



Cut-away view, below, re-drawn through courtesy of *Aircraft Production*, shows Armstrong-Siddely *Cheetah X* engine, which is used on large scale by the British Empire training scheme. Rated at 375 bhp., this engine has been approved for runs of 1,400 hr. between overhaul and for 1,200 hr. in England.

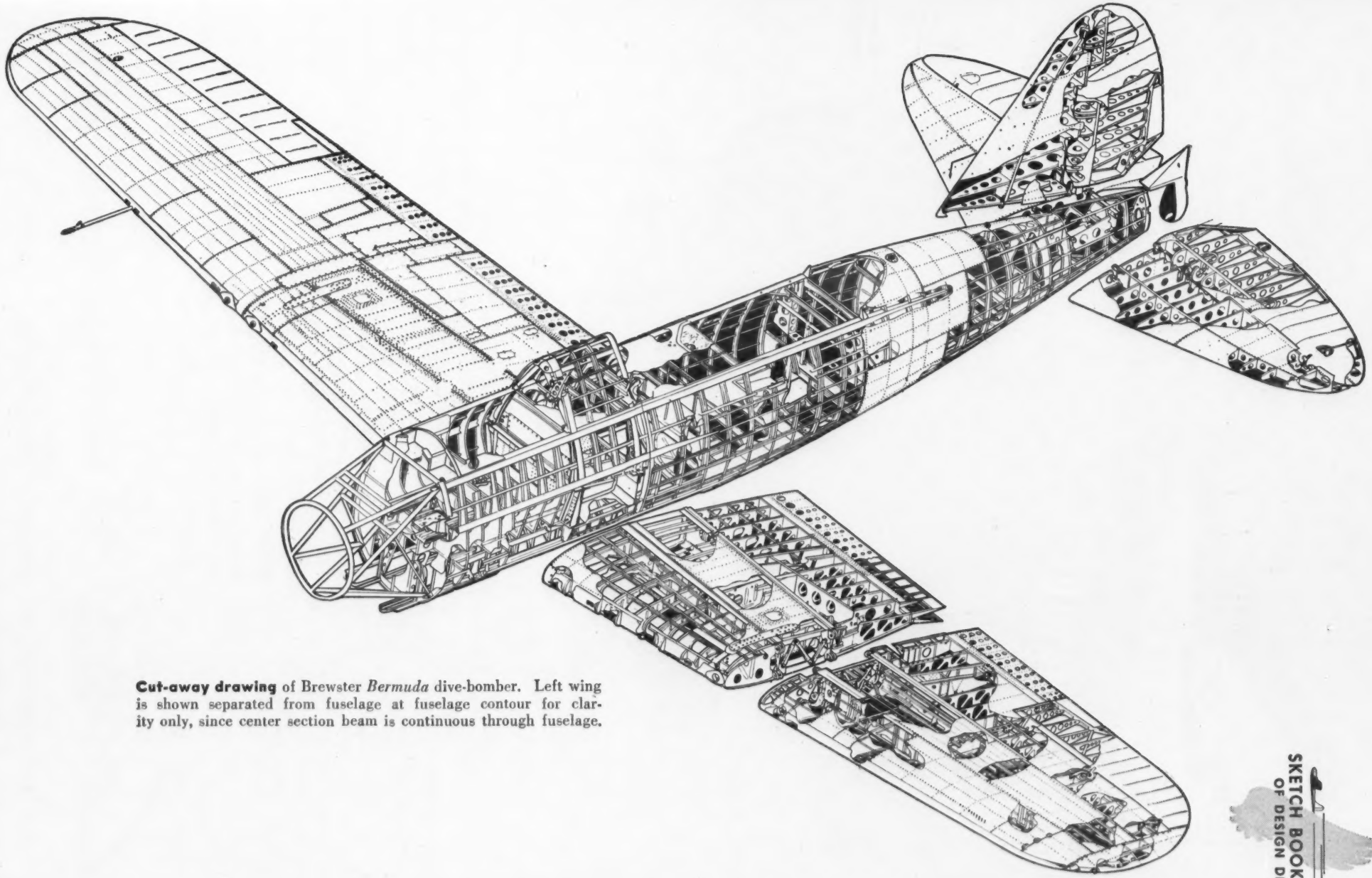


Maytag Hydraulics are easy to install



FOR MANY YEARS the world's leading manufacturer of domestic clothes washers, The Maytag Company, Newton, Iowa, is now devoting all of its efforts and facilities to the manufacture of a full line of Hydraulics of exclusive design... together with Eclipse electrical retracting units... and many types of aluminum alloy aircraft castings.

Maytag



Cut-away drawing of Brewster *Bermuda* dive-bomber. Left wing is shown separated from fuselage at fuselage contour for clarity only, since center section beam is continuous through fuselage.

SKETCH BOOK
OF DESIGN DETAIL

Model 20A

120 POUNDS— The Lawrance Model 20A, engineered to save vital space and weight, combines power and performance in a 120 pound unit only 30 inches long, 21 inches wide, and 17 inches high.

7½ KW— A continuous power rating of 5 KW, plus a 7½ KW overload rating, is an outstanding feature of the Model 20A. Vibration-free performance is insured by the high operating RPM of the 15 horsepower, two-cylinder engine.

DEPENDABLE— The Model 20A, now in service with the famous Boeing Flying Fortresses and Consolidated Liberators, supplies a steady and dependable flow of electric power to operate gun turrets, radio, bomb hoists, main engine starters and other vital equipment.

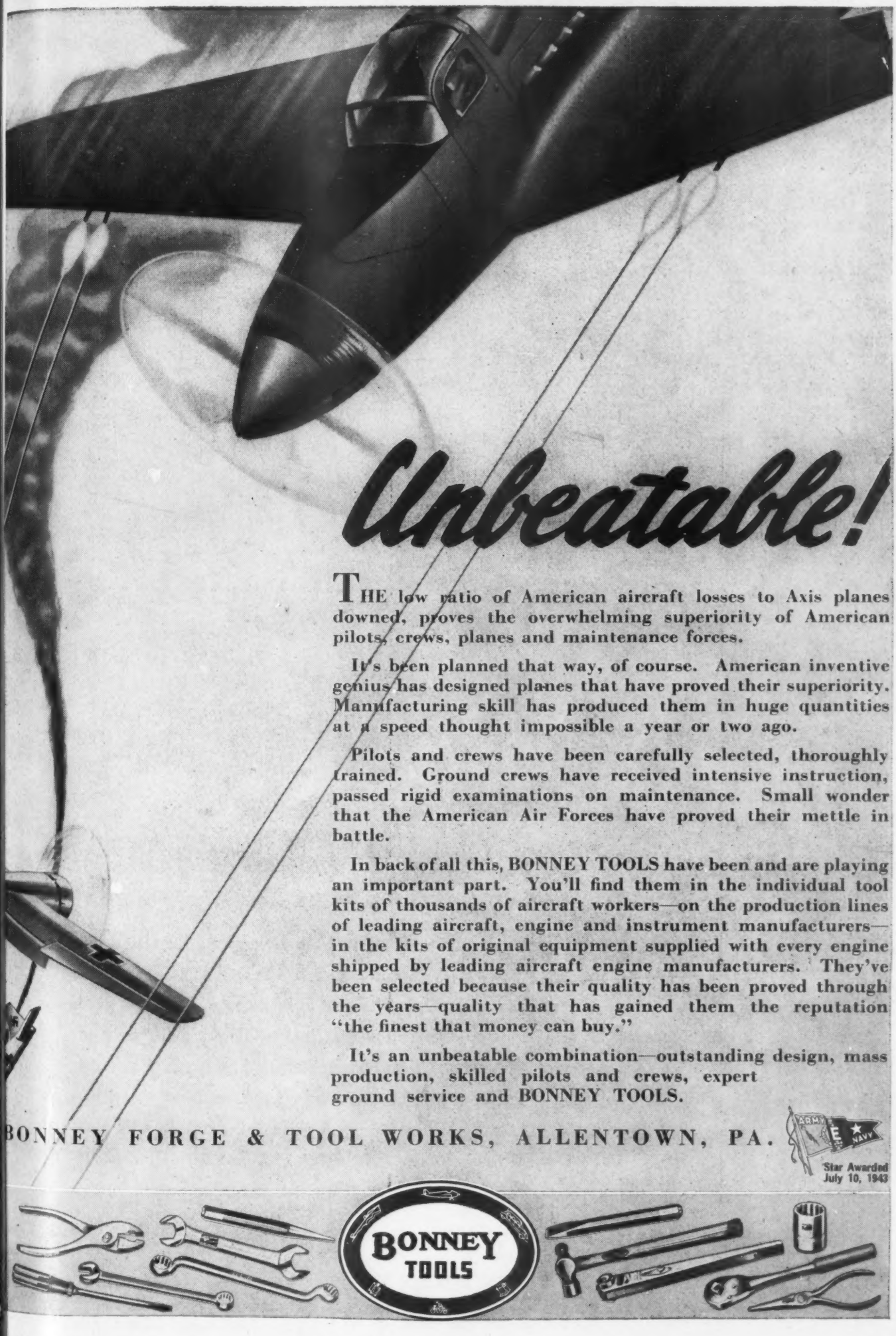
Other Lawrance Models:

In addition to the unit shown above, there is a Lawrance Auxiliary Power Plant to meet every Auxiliary Power need. Ranging in size from 2 to 5 cylinders, and in output from 5 to 15 KW, these Auxiliaries are in service today with our fighting forces of land, sea, and air. Write TODAY for illustrated folder.

LAWRANCE POWER

Lawrance AUXILIARY POWER PLANTS

LAWRANCE ENGINEERING AND RESEARCH CORPORATION • LINDEN, NEW JERSEY, U. S. A.



Unbeatable!

THE low ratio of American aircraft losses to Axis planes downed, proves the overwhelming superiority of American pilots, crews, planes and maintenance forces.

It's been planned that way, of course. American inventive genius has designed planes that have proved their superiority. Manufacturing skill has produced them in huge quantities at a speed thought impossible a year or two ago.

Pilots and crews have been carefully selected, thoroughly trained. Ground crews have received intensive instruction, passed rigid examinations on maintenance. Small wonder that the American Air Forces have proved their mettle in battle.

In back of all this, BONNEY TOOLS have been and are playing an important part. You'll find them in the individual tool kits of thousands of aircraft workers—on the production lines of leading aircraft, engine and instrument manufacturers—in the kits of original equipment supplied with every engine shipped by leading aircraft engine manufacturers. They've been selected because their quality has been proved through the years—quality that has gained them the reputation "the finest that money can buy."

It's an unbeatable combination—outstanding design, mass production, skilled pilots and crews, expert ground service and BONNEY TOOLS.

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

ARMY NAVY

Star Awarded July 10, 1943

BONNEY TOOLS

REPUBLIC
P-47 THUNDERBOLTS
are equipped with
WITTEK *AVIATION*
HOSE CLAMPS

On the offensive—with new weapons for allied victory—P-47 Thunderbolts! These fast firing heavily armored high altitude fighters are equipped with Wittek Aviation Hose Clamps. Today, as in the past, Wittek Aviation Hose Clamps, known as the standard of the industry, are being used by the nation's leading military aircraft and engine builders. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago 23, Illinois.

ARMY E NAVY

Back The Attack—Buy War Bonds

WITTEK *Aviation* **HOSE CLAMPS**

Association Standards For Copper and Brass

The Association has listed 38 copper base alloys commonly ordered in large quantities. Specifying of these alloys will simplify preparation of engineering specifications. Figures are standard specification numbers of American Ass'n. for Testing Materials.

NAME	COMPOSITION Percent	FORMS GENERALLY AVAILABLE *Indicated by (√) or by reference to nearest applicable A. S. T. M. Specifications*				
	Commercial Limits	Flat Rolled Products	Rod and Drawn Bar	Shapes	Wire	Tube
COPPERS					B1	
Electrolytic tough pitch copper	Cu 99.90 min.	B152 Type A	B124 #12 B133	B124 #12 B133	B2 B3	
Phosphorized copper	Cu 99.90 min.					B42, B68 B75, B88 B111
PLAIN BRASSES—NON-LEADED						
Gilding metal	Cu 93.5 –96.5 Zn Remainder	B36 #1				
Commercial bronze	Cu 89.0 –92.0 Zn Remainder	B36 #2 B130			B134 #2	√
Red brass	Cu 83.0 –86 0 Zn Remainder	B36 #3			B134 #3	B43 B111 B135 #1
Low brass	Cu 78.5 –81 5 Zn Remainder	B36 #4			B134 #4	
70/30 Brass	Cu 68.5 –71 5 Zn Remainder	B36 #6 B19			B134 #6	B14 B135 #2
High brass	Cu 63.0 –67.5 Zn Remainder	B36 #8			B134 #7	
Muntz metal	Cu 59.0 –63.0 Zn Remainder	√	B124 #1			B111 B135 #5
LEADED BRASSES						
Leaded commercial bronze	Cu 87.5 –90.5 Pb 1.25– 2.25 Zn Remainder		B140 Type B			
Low-leaded tube brass	Cu 65 0 –69.0 Pb 0.30– 0.80 Zn Remainder					B135 #3
High-leaded tube brass	Cu 65.0 –69 0 Pb 1.25– 2.00 Zn Remainder					B135 #4
Light-leaded brass	Cu 63.5 –67.5 Pb 0.15– 0.35 Zn Remainder	√				
Low-leaded brass	Cu 62.5 –66.5 Pb 0.30– 0.70 Zn Remainder	√				
Medium-leaded brass	Cu 62.5 –66.5 Pb 0.75– 1.25 Zn Remainder	√				
High-leaded brass	Cu 60.5 –64.5 Pb 1.25– 2.25 Zn Remainder	B121 #4				
Extra-high-leaded brass	Cu 60.0 –64.0 Pb 2.00– 3.00 Zn Remainder	√				
Free-cutting brass	Cu 60.0 –63.0 Pb 2.50– 3.75 Zn Remainder		B16	√		
Leaded muntz metal	Cu 58.0 –62.0 Pb 0.35– 0.90 Zn Remainder	B171				
Free cutting muntz metal	Cu 59.0 –62.0 Pb 0.90– 1.40 Zn Remainder					√

G.E. Announces

Factory-designed and -assembled for light weight and easy installation

You tell us the type motor you are using, the purpose for which it is to be used—we'll design the circuit, select the proper devices, assemble, wire, and test them as a unit, and deliver a complete control system to you, ready for installation. All the individual devices, such as relays, contactors, and switches, required for control of an electric motor are co-ordinated and compactly assembled in lightweight enclosures.

You get these advantages:

1. From our wide variety of aircraft control devices we can select those best suited to the job—often making one device do the work of two—with the greatest saving of weight and space.

2. Wiring, test, and assembly are completed at the G-E factory. Responsibility for the complete control system rests with one manufacturer.

3. Circuits are designed by G-E engineers who have had years of experience in the design as well as application of control equipment.

Next time you need aircraft control equipment, before you order individual devices, contact our nearest office and ask for more details on G-E packaged control. *General Electric Company, Schenectady, N.Y.*

The best investment in the world is in this country's future—BUY WAR BONDS

AIRCRAFT CONTROL

Reversing control for:

Nose wheels
Landing wheels
Landing and diving flaps
Bomb doors
Bomb hoists
Turret retractors
Wing-folding gear
Trim tabs

Nonreversing control for:

Hydraulic system pumps
Heat or air circuit fans
Cabin heaters
Engine heaters
Engine starters
Gasoline pumps

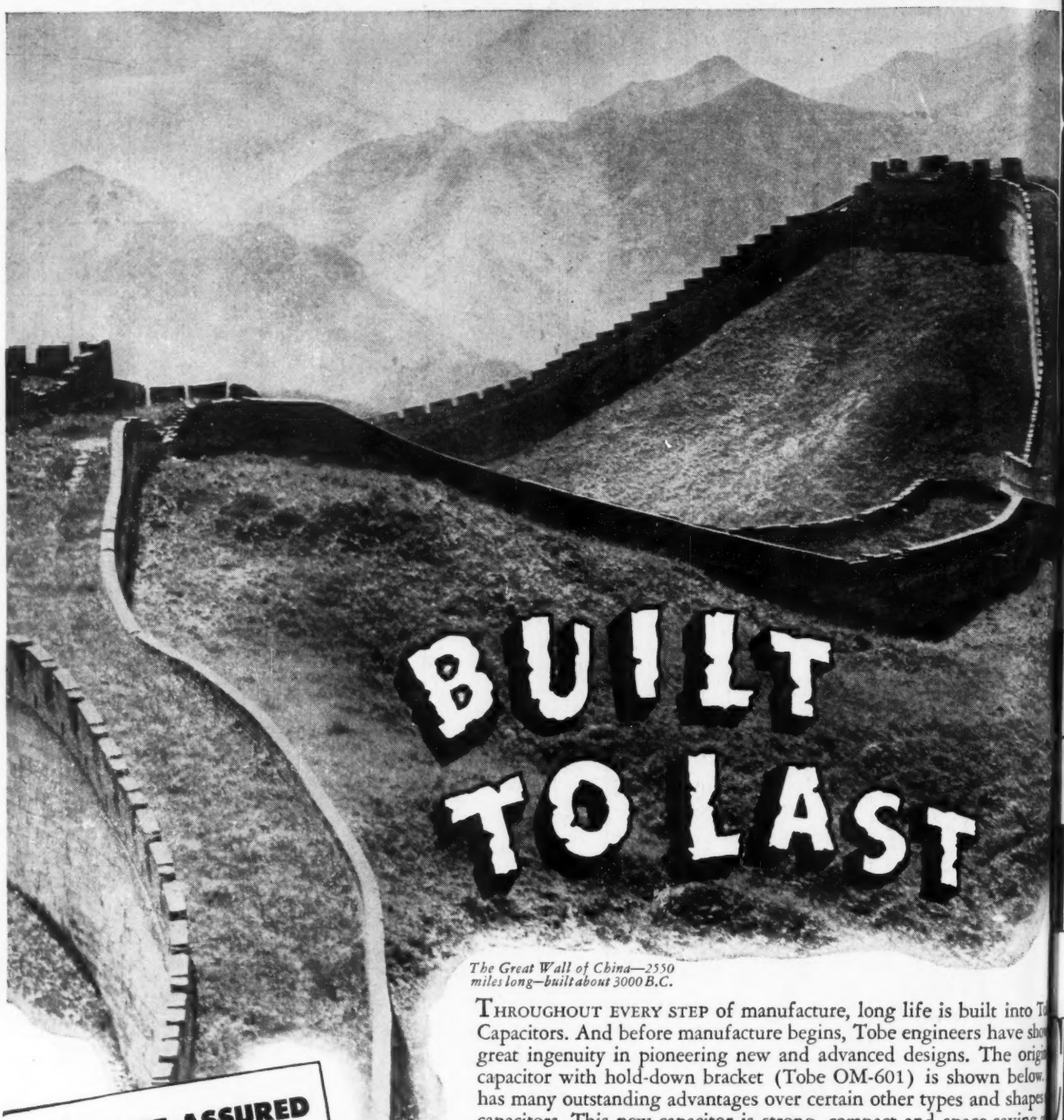
GENERAL ELECTRIC

GE 6-92-8940

NAME	COMPOSITION Percent	FORMS GENERALLY AVAILABLE *Indicated by (√) or by reference to nearest applicable A. S. T. M. Specifications*				
	Commercial Limits	Flat Rolled Products	Rod and Drawn Bar	Shapes	Wire	Tube
LEADED BRASSES (continued)						
Forging brass	Cu 58.5 –62.0 Pb 1.50– 2.50 Zn Remainder		B124 #2			
Architectural bronze	Cu 55.0 –60.0 Pb 2.00– 3.75 Zn Remainder			√		
TIN AND ALUMINUM BRASSES						
Admiralty	Cu 70.0 –73.0 Sn 0.90– 1.20 Zn Remainder					B111 Types A, B, C & D
Naval brass	Cu 59.0 –62.0 Sn 0 50– 1.00 Zn Remainder	B171	B21 GradeA B124 #3			
Leaded naval brass	Cu 59.0 –62.0 Sn 0.50– 1.00 Pb 1.25– 2.25 Zn Remainder		B21 Grade C			
Manganese bronze	Cu 57.0 –60.0 Sn 0.50– 1.50 Fe 0.80– 2.00 Mn 0.50 max. Zn Remainder		B124 #4 B138 TypeA			
Aluminum brass	Cu 76.0 –79.0 Al 1.75– 2.50 Zn Remainder					B111 Types A, B, C & D
PHOSPHOR BRONZES						
Phosphor bronze—Grade A	Cu Remainder Sn 3.50– 5.80 P 0.03– 0.35	B103 Grade A	B139 Grade A		B159 Grade A	√
Phosphor bronze—Grade C	Cu Remainder Sn 7.00– 9.00 P 0.03– 0.35	B103 Grade C	B139 Grade C		B159 Grade C	
Phosphor bronze—Grade D	Cu Remainder Sn 9.00–11.0 P 0.03– 0.25	B103 Grade D			B159 Grade D	
Phosphor bronze—Grade E-1	Cu Remainder Sn 1.50– 2.00 P Trace				√	
Phosphor bronze—Grade E-2	Cu Remainder Sn 1.00– 1.50 P Trace	√			√	
CUPRO-NICKEL and NICKEL SILVERS						
Cupro-nickel	Cu Remainder Ni 29.0 –33.0	B122 #5 B171				B111 (70–30)
Nickel silver alloy A	Cu 63.0 –66.5 Ni 17.0 –19.5 Zn Remainder	B122 #2	B151 Alloy A		B151 Alloy A	
Nickel silver alloy B	Cu 53.5 –56.5 Ni 17.0 –19.5 Zn Remainder	B122 #4	B151 Alloy B		B151 Alloy B	
SILICON BRONZES (Copper-silicon alloys)						
Silicon bronze—Type A	Cu 94.8 min. Si 2.75– 3.50	B96 TypeA B97 TypeA	B98 Type A		B99 Type A	√
Silicon bronze—Type B	Cu 96.0 min. Si 0.75– 2.00	B97 Type B	B98 Type B		B99 Type B	√
Silicon bronze—Type D	Cu 94.0 min. Si 2.75– 3.50 Pb 0.20– 0.80		B98 Type D			

The alloys listed hereon are standard in the sense that over a period of years they have been the ones most commonly ordered in large quantities by consumers.

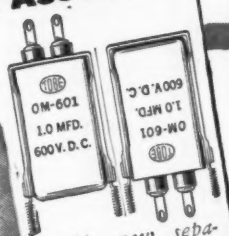
In addition to these alloys, there are many special and proprietary alloys which can be and are produced by the mills for various uses, including such types of alloys as aluminum bronze, cadmium bronzes, beryllium coppers, aluminum-tin bronzes, aluminum-silicon bronzes, silicon bronzes, copper-chromium alloys, etc.



The Great Wall of China—2550 miles long—built about 3000 B.C.

THROUGHOUT EVERY STEP of manufacture, long life is built into T Capacitors. And before manufacture begins, Tobe engineers have sho great ingenuity in pioneering new and advanced designs. The origi capacitor with hold-down bracket (Tobe OM-601) is shown below. has many outstanding advantages over certain other types and shapes capacitors. This new capacitor is strong, compact and space-saving the new hold-down bracket permits use of either inverted or upright te nals, with wiring underneath or on of chassis. Write us about your capac problems. They will have the best effo of Tobe engineers.

LONG LIFE ASSURED



This new separate mounting is stronger and helps prevent leaks caused by breaks in can. This outstanding Tobe design takes the minimum amount of space.

SPECIFICATIONS
TOBE OM-601 CAPACITORS

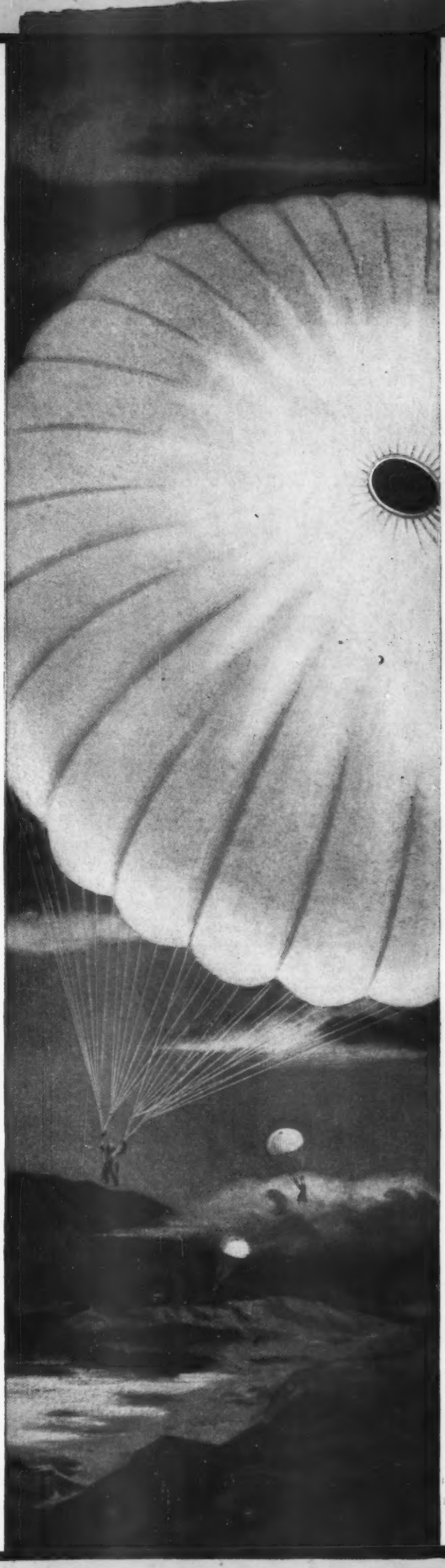
TYPE	OM
RATINGS	.05 to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
STANDARD CAPACITY TOLERANCE	. . . 10%
TEST VOLTAGE	. . . Twice D.C. rating
GROUND TEST	. . . 2,500 Volts, D. C.
OPERATING TEMPERATURE	55° F to 185° F
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms.
POWER FACTOR	At 1,000 cycles—.002 to .005
CONTAINER SIZE	Width 5/8", length 1 5/16", ht. 2 1/4"
MOUNTING HOLE CENTERS	1 1/2"

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

A small part in victory to

A BIG PART IN INDUSTRY TOMORRO

ONE MILE DOWN TO CHRISTMAS



Out we go at around five thousand . . . I never thought my Christmas tree would be a 'chute!

Here I am, though . . . on this Holy Night . . . drifting down to earth . . . to finish this job.

Time's short . . . and you know, as I look down below . . . I say a silent prayer . . . whisper it to the air.

Now . . . I'm coming down . . . coming down all *safe* and *sound!* coming down . . . to make "Peace on Earth . . . Good Will to Men!" a living reality.

And next year . . . Back to a Christmas tree that's green . . . decorated with tinsel and ornaments . . . standing in a room that's quiet and serene . . . where a fire on the hearth glows warm and friendly. Back home! Back to my freedom!

Back to my own little mansion . . . back to the ones I love!

And, Sky Soldier, to bring you back safely, we are working day and night. To you . . . and all like you . . . to your loved ones, too . . . we send our grateful Christmas greetings! ☆ ☆ ☆ ☆

ARMY E NAVY

SWITLIK

SAFE-T-CHUTES

Air Power is winning the war . . . The more Bonds you buy . . . the more hours they fly!

SWITLIK PARACHUTE COMPANY

Trenton, New Jersey

Review of Patents

By A. HARRY CROWELL,
Registered Patent Lawyer

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York City (18). Printed copies of any of patents listed are obtainable at a cost of 10c. each, directly from U. S. Patent Office, Washington.

Steerable Tail Wheel, of caster type, is designed to be steered by means of rudder controls. Mechanism is automatically disengaged upon takeoff so rudder controls may be more easily moved.—2,329,823, filed Mar. 25, 1940, patented Sept. 21, 1943, E. A. Camburn, assignor to Lake State Products, Inc.

Airfoil With Capped Ribs. Patent is for rib-and-fabric type airfoil. Here, ribs are jointed-in solidly with a cap piece extending around periphery of airfoil.—2,329,962, filed Aug. 9, 1941, patented Sept. 21, 1943, G. A. Weingartner, assigner to Bell Aircraft Corp.

Re Wing Leading Edges. Invention here is for a prefabricated wing in which leading edge element of multi-part wing is attached to rest of wing with special bolting arrangement to eliminate necessity of access holes through skin.—2,330,185, filed Dec. 5, 1940, patented Sept. 21, 1943, R. W. Palmer, assignor to Vultree Aircraft, Inc.

Multi-Rotor Aircraft. This design is for helicopter in which a pair of opposed rotors are mounted on ends of laterally extending spars and with a third rotor mounted on fuselage with its plane of rotation slightly higher than that of the pair of rotors. Center rotor overlaps half of lower rotors, and combined effect is one of a rotor with a greatly increased radius.—2,330,204, filed Sept. 15, 1941, patented Sept. 28, 1943, H. S. Campbell, assigned to Autogiro Co. of America.

Metal Covering for Airfoils incorporates a sheet to reinforce wing covering. This sheet is stamped into a waffle-like appearance, with centers of depressions cut out to reduce weight. Sheet is then welded to surface covering between depressions.—2,330,219, filed Aug. 13, 1940, patented Sept. 28, 1943, P. H. Kemmer. Freely licensed to government.

"Anti-Flapping" Rotor. Invention concerns rotor arrangement in a helicopter in which blades are universally mounted so they may have a cyclically controlled pitch varied according to rotational position of rotor blade, aim being to eliminate "flapping".—2,330,842, filed May 27, 1940, patented Oct. 5, 1943, C. G. Pullin, assigned to Autogiro Co. of America.

Treating of Aircraft Fabrics and products thereof. Method to prevent mildew contemplates use of copper naphthenate mixed into a doping solution. Fabric is attached to a structural framework of an aircraft, and thereafter water and a mildew-proofing agent is applied to fabric to shrink it. When fabric has shrunk and dried, a protective coating is applied.—2,330,998, filed Oct. 24, 1941, patented Oct. 5, 1943, L. Roon, assigned to Roxalin Flexible Finishes, Inc.

Balanced Control Surface. Improvement concerns a sealing membrane for open portion on trailing edge of wing adjacent to flap mounting, membrane consisting of two separate members formed into continuous sleeve extending across complete wing edge. Sleeve is inflated by a tube leading to forward edges of wing, where it has an open mouth forwardly directed.—2,331,047, filed Oct. 9, 1942, patented Oct. 5, 1943, G. S. Schairer, assigned to Boeing Aircraft Co.

Steerable Undercarriage aims to permit gear to be retracted into much smaller area. It is so mounted that wheel member may be swung so as to lie flat in retracted position.—2,331,082, filed June 30, 1941, patented Oct. 5, 1943, H. H. Smith, assigned to Dowty Equipment, Ltd.

Emergency Exit Catapult. This invention is for a pilot-ejecting device for a fighter ship which has become disabled. Principle is to use airfoil-shaped member which when released on forward edge, will fold back pulling pilot from seat to toss him out past all obstructions on ship.—2,331,309, filed Nov. 24, 1941, patented Oct. 12, 1943, L. E. Curriston, freely licensed to government.

Chute-Carrying Garment has parachute-carrying arrangement provided in place of usual chute pack. Provided is pocket in back covered with pair of flaps which are loosened when chute is to be used.—2,331,727, filed July 18, 1941, patented Oct. 12, 1943, J. R. C. Quilter and J. Gregory.

Launching Dollies. Invention relates to airplane takeoff devices adapted to travel with plane until flying speed is attained and then be released. There are two forms, one for water use, other for land. Water-born device is self-propelled.—2,331,837, filed Sept. 6, 1939, patented Oct. 12, 1943, F. W. King.

Shock-Absorbing Ski Mounting. Arrangement is designed to maintain skis parallel to fuselage at all points of compression of shock absorber. This is accomplished by use of a parallel link mounting for skis and for shock absorber, with shock absorber replacing one of links.—2,332,021, filed May 22, 1941, patented Oct. 19, 1943, H. H. Smith, assignor to Dowty Equipment, Ltd.

New Friction-Reducing Coating, for exterior surfaces of an airplane, is intended to improve speed and performance of craft. Coating comprises mixture of nitrocellulose, castor oil, ortho toluene, ethyl sulfonamid, finely powdered graphite, and ethyl acetate.—2,332,196, filed Oct. 4, 1940, patented Oct. 19, 1943, J. Bjorksten.

"No-Break" Retractable Gear. Construction of this undercarriage is so links need not be "broken" to fold into retracting position. Fore and aft shift in weight during retraction is reported so slight that trim of ship is not appreciably changed.—2,332,453, filed July 15, 1941, patented Oct. 19, 1943, E. S. Martin, assignor to North American Aviation.

Aerodynamic Brake arrangement comprises series of tooth-like members adapted to be thrust simultaneously into airstream both above and below wing surface to increase drag on wing without imposing additional twisting stresses.—2,332,465, filed Aug. 23, 1939, patented Oct. 19, 1943, J. G. Lee and R. B. Beisel, assignors to United Aircraft Corp.

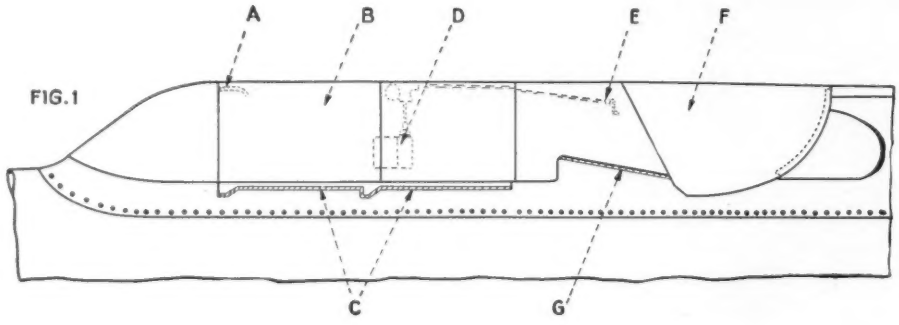


FIG. 1

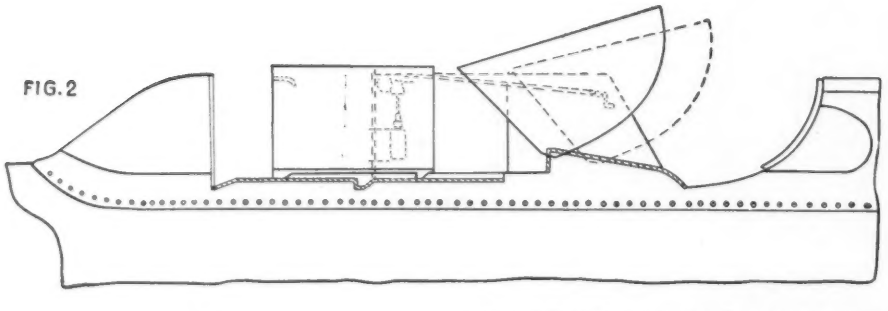


FIG. 2

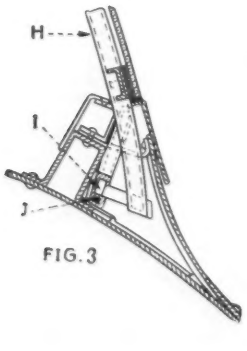
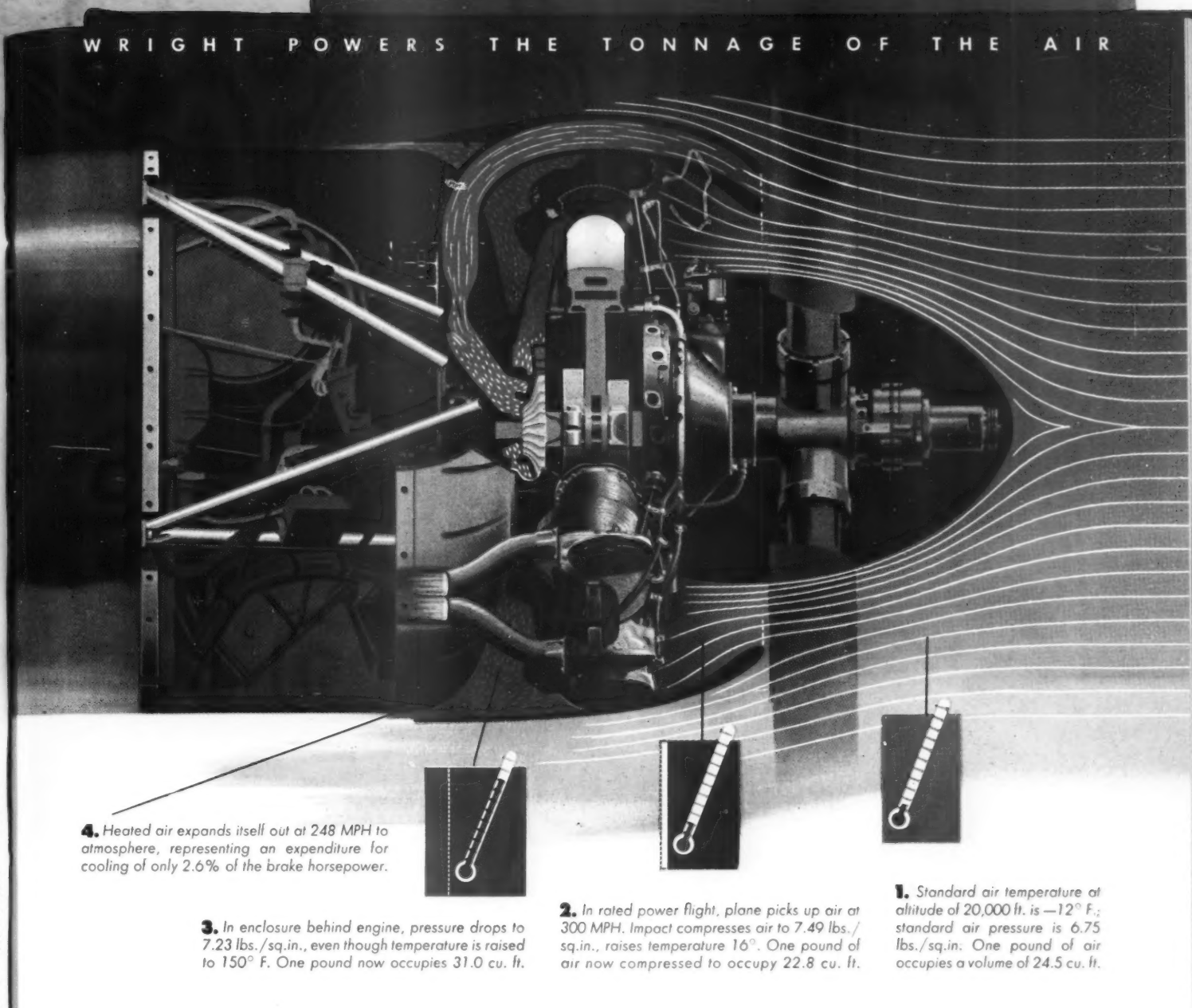


FIG. 3

Prime purpose of warplane cockpit cover design (illustrated left) is to achieve flush-closing of "greenhouse," thus doing away with stepped or irregular features which in former telescoping enclosures have induced drag. In this form, all cover units are of same cross-section size. With handle *A* (Fig. 1) pilot slides back his cockpit cover *B* over special track *C* built to lift, expand, and guide it over fixed enclosure immediately aft. In like fashion, motor *D* (operated by pilot) or manual crank *E* (used by gunner) brings gunner's cockpit cover *F* forward on track *G*. Fig. 2 shows pilot's cover in half-open position and gunner's cover fully open. When former is fully open, latter is partially open, as depicted in dotted lines. Note that gunner's cover swings up to act as wind screen. Fig. 3 shows detailed transverse section of tracking arrangement. Seen at *H* is edge portion of cover, while *I* is roller unit, and *J* is track. Patent, filed Dec. 30, 1939 and granted Oct. 19, 1943, is No. 2,332,158. It went to Harry S. Magill and Ernest G. Bruce, who have assigned it to Vultee Aircraft, Inc.

WRIGHT POWERS THE TONNAGE OF THE AIR



4. *Heated air expands itself out at 248 MPH to atmosphere, representing an expenditure for cooling of only 2.6% of the brake horsepower.*

3. *In enclosure behind engine, pressure drops to 7.23 lbs./sq.in., even though temperature is raised to 150° F. One pound now occupies 31.0 cu. ft.*

2. *In rated power flight, plane picks up air at 300 MPH. Impact compresses air to 7.49 lbs./sq.in., raises temperature 16°. One pound of air now compressed to occupy 22.8 cu. ft.*

1. *Standard air temperature at altitude of 20,000 ft. is —12° F.; standard air pressure is 6.75 lbs./sq.in. One pound of air occupies a volume of 24.5 cu. ft.*

A Direct Approach to Cooling

All aircraft engines are cooled by air, whether the air passes through a radiator containing intermediate coolant, or passes directly across finned cylinders. Wright Aeronautical has produced both types of engines, and in developing the history-making Cyclone series has advanced the science of direct air cooling to the point where Cyclones produce more power per unit of space and weight than any other powerplant of any type.

Years ago, air cooled engines were mounted in the open, without cowling. While this provided effective cooling under most operating conditions, the resultant drag exacted a high toll from the power available for thrust. Present-day engine powers and aircraft speeds have depended in large measure on two simultaneous developments — increased cylinder finning and scientific cowling.

With each increase in the number and depth of cylinder cooling fins, engine powers have gone up. In ten years, the rating of the Cyclone 9 has been raised 80% without increase in displacement. The latest development in cylinder design, incorporating a forged head with machined fins, permits as much as 15% increase in Cyclone power without adding to the size or weight. Better heat conductivity of the forged metal, plus extra-deep fins, make Cyclones with these new cylinders the easiest of all engines to cool.

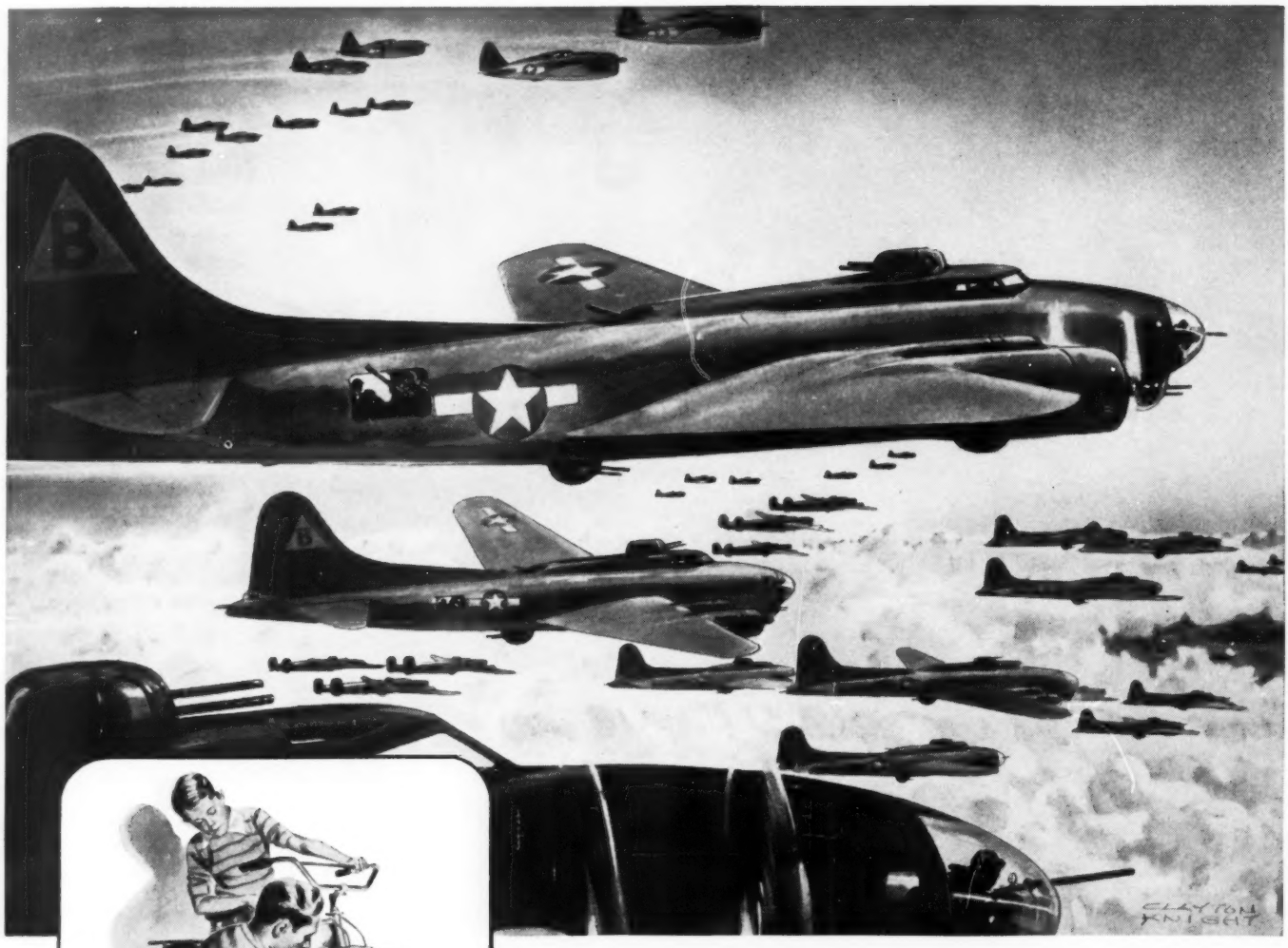
Engine cowling, meanwhile, has been refined to the point where it serves as a pump to supply cooling air to the engine and control its return to the slip-stream. In cooling an engine, still air is picked up and swept along momentarily at plane speed, then returned to surrounding air. Unless it is ejected at approximately the speed with which the plane picked it up, the forward velocity which it retains represents a serious loss of energy. The reduced cooling effort required by the Cyclone engine permits reduction of this cooling drag to negligible values in high speed flight, as shown in the illustration above.

Direct air cooling, which requires a minimum of installation weight and few moving parts, is a feature which has long established the Cyclone as an economical source of power. The marked pay load advantage and ease of maintenance means additional revenue dollars for the operator.

★ ★ ★

Wright Cyclones pay their way.

Cyclones and Whirlwinds · Light · Compact · Powerful **WRIGHT** *Aircraft Engines*



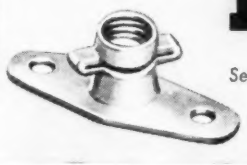
Boots Will Eliminate This Chore After Victory

Often Bill's bike shakes and shimmys so badly that he can't ride it safely. Normal vibration loosens wheel nuts—probably every other nut too—so Dad has to get a wrench and tighten up the whole bike. But after the war, Bill will ride safer and Dad will be spared many a tightening-up session, because well-made bikes will wear Boots Self-Locking Nuts. Even severe vibration can't shake Boots Nuts loose. For safety's sake and to eliminate repairs caused by vibration-loosed connections, you will insist on products protected with Boots Self-Locking Nuts.

They Fly With Their Boots On—Farther

Boots All-Metal Self-Locking Nuts are lighter than any other similar fastenings. On a single Liberator or Flying Fortress they save up to 80 pounds. That's enough to enable one of these 4-engine giants to take along extra gallons of gasoline—or 200 additional rounds of .50 caliber machine gun ammunition. A little extra range or a few more bullets may be just what's needed to get a bomber home from a 2,000 mile raid over enemy territory.

In case you're wondering whether nuts as light as Boots can "take it," there is plenty of evidence to prove just how tough they really are. They withstand the corrosive action of oil, salt water and chemicals. No amount of plane vibration can loosen their grip. Boots Nuts can be used over and over again—literally "outlast the plane." In fact, today these nuts are worn by every type of U.S. aircraft. Yes, Boots Nuts meet the exacting specifications of all government aviation agencies.



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CRUISE CONTROL For Flying Efficiency

AIR TRANSPORT

Part V . . . Time and Fuel Requirements

By **DIXON SPEAS**, *Asst. to Vice-Pres., Engineering,*
JERE T. FARAH, *Chief Flight Analyst,*
SANFORD HINTON, *Flight Analyst,*
American Airlines

Methods of determining flight time and fuel requirements under varying weather conditions.

FLIGHT PLANNING consists of several very important steps. First, and most important, is determination of the type of cruise control which will be used. The various factors affecting this choice are discussed elsewhere in this series. The second step consists of determining the time and fuel required, while the third phase is the determination of the amount of reserve fuel to be carried during the planned flight.

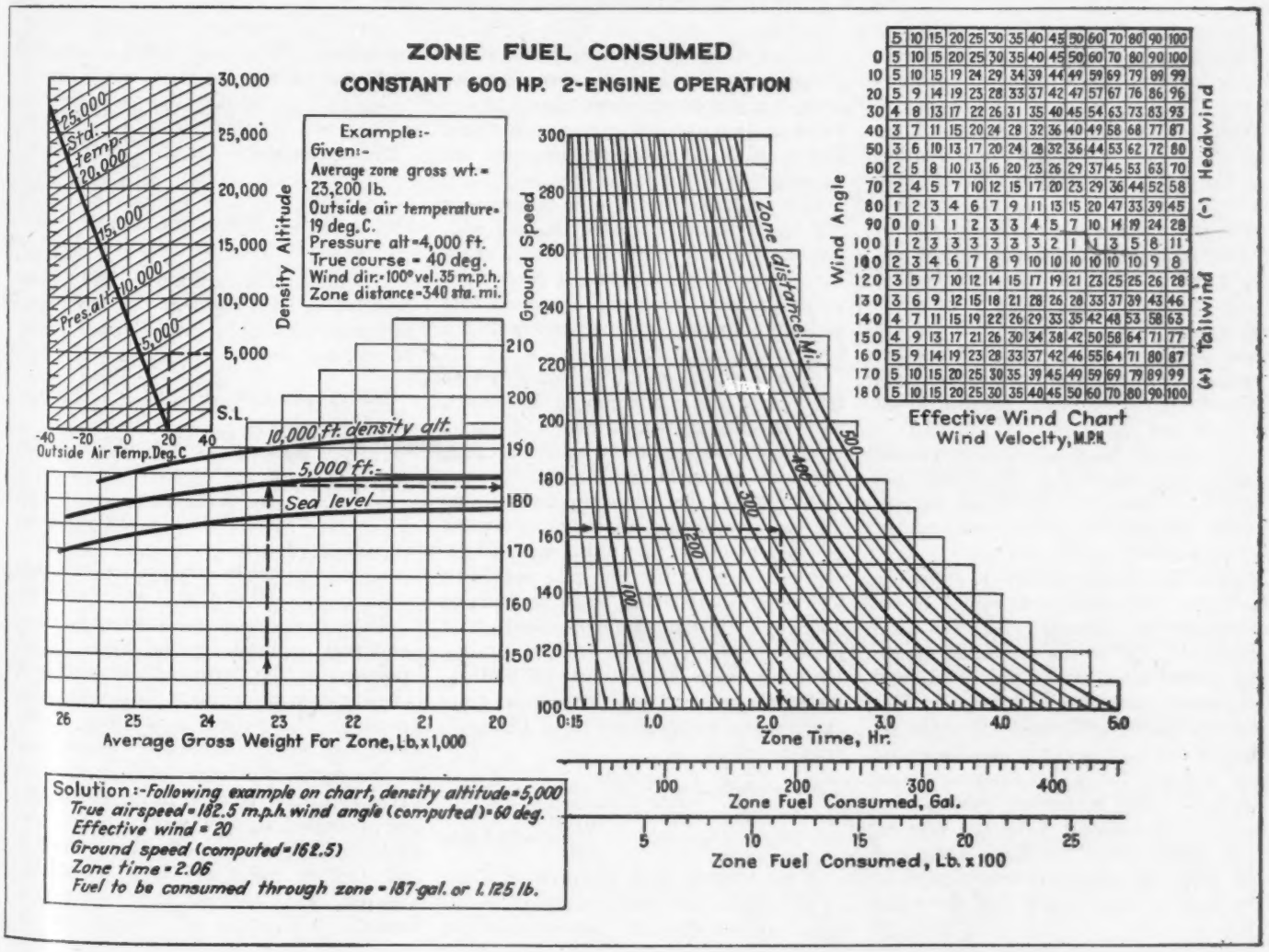
In establishing the amount of fuel and the time requirements for any flight, several phases are considered, as follows:

1. Taxi, run-up, and takeoff
2. Climb
3. Cruise
4. Descent
5. Reserve

The taxi, run-up, and takeoff operation is variable and does not lend itself to an accurate analysis.

If the airplane has been warmed up and checked by a mechanic, allowances should be made in determining the fuel load. Often, however, the tanks are filled or topped off after this check, or the engines are warm if it is an intermediate stop, in which case no allowance need be made for warm-up and run-up. A reasonable figure for twin engines of about 1,100 hp. is 5 to 10 gal., but this is highly variable, depending on the outside air temperature, which affects the time of warm-up, the priming, etc. A four-engine airplane will take approximately twice as much as two engines, and four engines having turbosuperchargers, which require running at takeoff power during the ground check, will require approxi-

Fig. 1. Zone fuel consumption and effective wind charts.



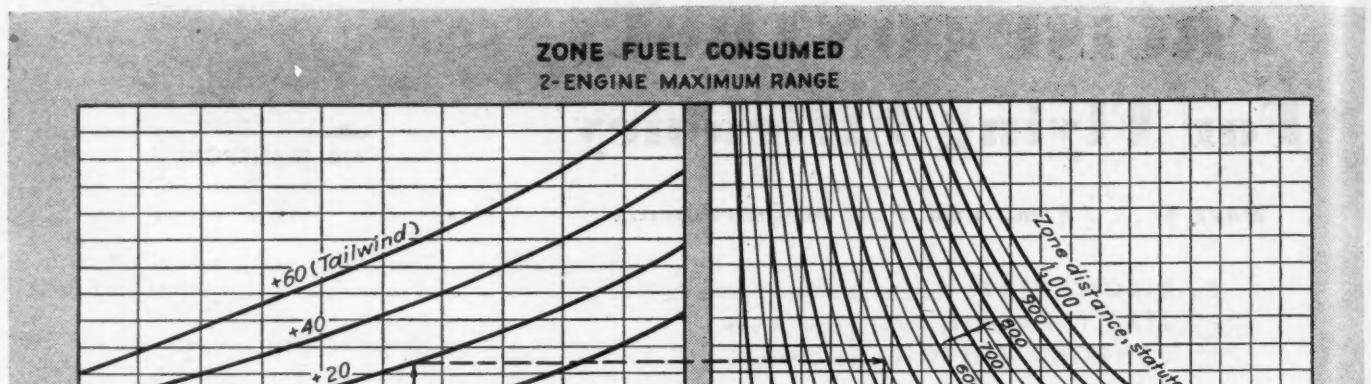


Fig. 2. Chart giving effect of wind on fuel consumption.

mately 20 gal. Engines of higher horsepower require fuel directly in proportion to their power.

Fuel for taxiing is a function of the size of the field and is therefore a rather indefinite factor. A fair fuel estimate is 5 to 10 gal.

The run-up before takeoff is influenced by the horsepower and number of engines and whether or not the airplane has turbosuperchargers. A twin-engine airplane as described above will require about 5 gal., four engines will require twice this amount, and an airplane with turbosuperchargers will require about 12 to 15 gal.

The takeoff lasts about one minute and requires approximately 2 gal. per 1,000 hp. Thus two 1,100 hp. engines require 4.4 gal., which for purposes of flight planning would be 5 gal.

With the above factors in mind, a flat figure is usually determined as an allowance for ground operation and takeoff. For a DC-3's scheduled operation (engines warm) 10 gal. is allowed for ground operation and takeoff. The time for taxiing and run-up is about six minutes for a twin-engine airplane and nine minutes for a four-engine plane.

Because of the higher power, rich mixtures, and slower airspeeds encountered during the climb, both more fuel and time are required than would be the case in level flight for the same distance.

It is convenient in flight planning to compute the fuel and time required to cover a given distance and then add the extra amounts resulting from the climb. For a DC-3 the extra requirements are as shown in Table I.

If a flight plan were to be made using 600 hp., cruising at 10,000 ft. and with an effective headwind of 20 mph., using the above table, 19 gal. and three min. would be added over and above the fuel and time requirements necessary for a level cruising flight.

Such a table would be computed as follows: Assume a climb to 10,000 ft. with an effective headwind of 20 mph., level flight cruising to be at 600 hp., the climb to be made at 650 hp.

Assume a fuel consumption at 600 hp. with cruising mixtures to be 90 gal. per hour and at 650 hp. with climbing mixtures to be 130 gal. per hour. The climb to 10,000 ft. is to be made at 120 mph. instrument air speed, with a rate of climb of 650 ft. per minute. Cruising speed at 600 hp.—10,000 ft., 25,000 lb. gross wt.—is determined from the cruising power chart to be 188 mph. true airspeed.

$$\text{Time to climb} = \frac{\text{altitude}}{\text{rate of climb}} = \frac{10{,}000}{650} = 15.4 \text{ min.}$$

With average true airspeed in climb at 120 mph., instrument airspeed is 133 mph. (from cruising power chart or calculator, taking into account installation error of 4 mph.)

$$\text{Ground speed} = 133 - 20 = 113 \text{ mph.}$$

$$\text{Distance traveled} = 113 \times \frac{15.4}{60} = 28.5 \text{ mi. in climb.}$$

$$\text{Fuel in climb} = 130 \text{ gal. per hour} \times \frac{15.4}{60} = 33.5 \text{ gal.}$$

If the same distance had been traveled in level flight at 188 mph. true airspeed, 168 mph. ground speed, and 90 gal. per hour:

$$\text{Time required} = \frac{28.5}{168} \times 60 = 10.2 \text{ min.}$$

$$\text{Fuel required} = \frac{90 \text{ gal./hr.}}{60} \times 10.2 = 15.3 \text{ gal.}$$

Difference in time = time to climb minus level flight time = 15.4 − 10.2 = 3.2 min.

Difference in fuel = fuel for climb minus level flight fuel = 33.5 − 15.3 = 18.2 gal.

Determination of the amount of time and fuel required for the "level flight" portion, or the "cruising" requirement, is of course of primary importance because of the major proportion of the fuel load which the "cruise" constitutes.

Procedure for such determination of fuel and time required in the cruise will be discussed in two ways: First, considering the basic methods of analysis of factors affecting these quantities; second, the devices such as charts, graphs, computers, etc., which are de-

signed to facilitate a rapid, accurate estimate of these requirements.

Several quantities are required to be known for the analysis: Flight length, engine power to be used, fuel consumption at various powers, cruising altitude or altitudes, effective wind at those altitudes, and speed-power relationships of the airplane.

Flight length is ordinarily quite accurately known from airway or route maps. For flight planning, particularly on trips of great length, it is desirable to divide the total mileage into several short legs of approximately equal length, usually 200-400 mi. Each of these legs is then treated separately, and the time and fuel required for each leg, or "zone", is computed individually.

Choice of engine power to be used was discussed in previous articles of this series. The power control type will, of course, be either of constant power or of varying power such as is used in attaining maximum range. Constant power offers simplicity of flight planning, since the rate of fuel consumption will remain constant. When the power is to be varied, the changing fuel consumption per hour adds a slight complication to the problem. In either case it is necessary to have an accurate knowledge of the fuel consumption for each power to be used.

If no figures are available, a reasonable specific fuel consumption should be assumed; for cruising powers (below the cruising power limit) a "specific" of 0.45 lb. hp.-hr. can be assumed with lean mixtures. Thus, if 600 hp. is to be used for the flight, or a portion thereof, the engine can reasonably be expected to consume $600 \times 0.45 = 270$ lb. of fuel per hour, or 45 gal. per hour at a fuel weight of 6 lb.-gal. This consumption is, of course, per engine, and it must be multiplied by the number of operative engines.

Next problem is to determine the ground speed which will be maintained through each leg or zone of the flight. This, in the case of constant power operation, will be determined by density altitude, airplane weight, and effective winds encountered.

Effective wind is found by trigonometrical analysis of the airspeed-wind-speed triangle. This is accomplished more easily by using one of several available avigational computers, or from a chart such as is shown in Fig. 1. The effective wind is found by knowing the wind angle, or angle between the true course and the wind direction, and the wind velocity. At the intersection of the wind angle column (60 deg. in example) and wind velocity column (35 mph.), read the effective wind −20 mph. (headwind).

In the case of maximum range cruise control, the instrument airspeed is given for each gross weight of the airplane, in which case it is necessary to determine the power required to obtain that airspeed. Power changes, due to gross weight decrease through fuel consumption, are made at intervals of the airplane's decreasing weight.

For these speed-power-weight-altitude relationships, the cruising horsepower chart, as described in a previous article of this series, is used. The ground speed to be expected in each zone will be determined by the true airspeed minus headwind or plus tailwind.

Summarizing the basic method of time and fuel requirement analysis, the procedure is as follows: Determine true airspeed for the zone from a chart of speed-power relationship, such as the cruising horsepower chart, using the known values of altitude, average zone gross weight, horsepower (if known)[1], and instrument airspeed (if known)[2].

Add effective wind for zone, if tailwind, to true airspeed. Or subtract effective headwind, as the case may be, to determine ground speed.

Obtaining Zone Time

Divide zone length by the ground speed, to obtain the time required for that zone. The foregoing procedure is repeated for each zone.

Fuel consumed through the zone is obtained by multiplying zone time hours by the fuel consumption (gal.-hr.) to obtain the zone fuel consumed, or fuel to be used in flying through the zone. This, too, is repeated for each zone. The time and fuel required for the entire flight will then be the total of all zone times and zone fuel consumed.

Amount of time and effort involved in making an analysis of cruising flight time and fuel required in the manner described above is, to say the least, excessive, particularly when several altitudes are considered. Therefore it becomes desirable in routine operation to eliminate as many of the steps as possible through the use of pre-calculated charts and graphs. Many types of flight planning charts have been devised and successfully used for that purpose. Several in current use are described below.

Fig. 1 illustrates a chart designed for use with a constant power type cruise control (600 hp.). To determine the time and fuel required in cruising level flight through a given zone, it is necessary to know the average airplane gross weight for the zone, the cruising altitude, the effective zone wind, and the zone distance. In the example of Fig. 1., the gross weight is 23,200 lb., assumed pressure altitude 4,000 ft., air temperature at that altitude 20 deg. C., zone distance 340 mi. Cruising density altitude is to be determined from the standard atmosphere chart (see example in upper left corner of Fig. 1), as discussed previously in this series, or by following the examples shown.

Locating the zone gross weight (23,200 lb.) on the horizontal scale at the left of the chart, proceed vertically upward to the line of cruising density altitude (5,000 ft.), then right horizontally to read the true airspeed of 182.5 mph. Subtract the effective headwind of 20 mph. and enter the ground speed scale at 162.5 mph., then go to the right until the zone distance of 340 mi. is intersected. Vertically below this point, the time and fuel required for the subject zone may be read (2 hr. 6 min. and 187 gal. of gas). It must be remembered that these types of pre-calculated charts are based on the fundamental speed-power characteristics of the airplane and therefore must be calculated for each specific type of airplane flown.

Fig. 2 shows a similar type of chart based upon maximum range operation. It will be noted that the zone time is not given by this chart, since it is not possible to include this scale because of the fact that though the miles per gallon remain substantially constant with altitude (assuming constant specific fuel consumption and propulsive efficiency) the true air speed varies as altitude changes for a given instrument airspeed.

(*Turn to page* 324)

[1] As in constant power operation.
[2] As in maximum range operation.

TABLE I — Fuel and Time Allowances for Climb, DC-3 Typical Airplane

Altitude	Fuel allowance—gal. Cruising power per engine				Time allowance—min. Wind mph.						
	500hp.	550hp.	600hp.	650hp.	−60	−40	−20	0	+20	+40	+60
2,000	4	4	4	4	1	1	1	1			
4,000	8	8	8	7	1	1	1	1	1	1	1
6,000	12	12	11	11	2	2	2	2	1	1	1
8,000	17	16	15	15	3	3	3	2	2	2	2
10,000	21	20	18	18	4	3	3	3	2	2	2
12,000	26	25	22	22	5	4	4	3	3	3	3
14,000	31	30	27	26	6	5	5	4	4	3	3
16,000	37	35	33	31	7	6	6	5	5	4	4
18,000	44	41	39	37	9	8	7	6	6	5	5
20,000	52	48	46	44	10	8	7	7	6	6	5

P-51 Mustang
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...provides Extra Range
The P-47 Thunderbolt and the P-51 Mustang—champions in dishing out destruction—now are flying higher and farther, equipped with Standair Fuel Tank Pressure Control Valves insuring a positive flow of fuel from wing tanks, belly tanks, or regular supply tanks. In addition, Standair manufactures other instruments engineered for the job—matching the high standards of precision established by the U. S. Army Air Forces and leading aircraft manufacturers. Write or wire for specifications.
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P-47 Thunderbolt

PRESSURE CONTROL VALVE

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Model FAZ

Designed to eliminate the boiling of fuel at high altitudes, by pressurizing the fuel tank. It is equipped to automatically provide for varying atmospheric conditions existing in fuel systems. Operating pressure is derived from exhaust of supply pump. Systems can be pressurized starting at any predetermined altitude at pressure required.

Weight 1 lb. 2 oz.
4 ¼ in. x 5 in.
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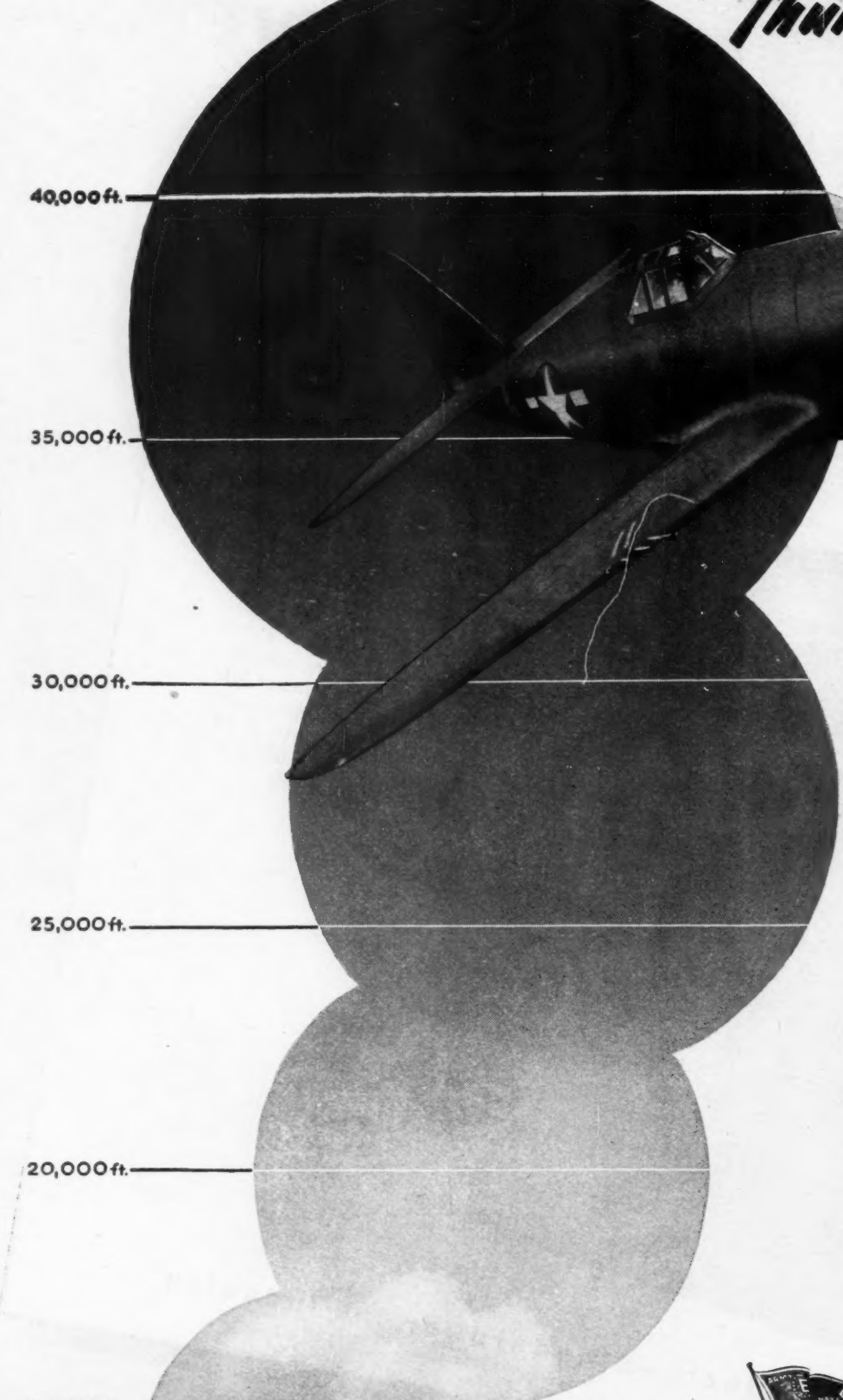

Highway patrol

Sure, you've read this story before. It's in your newspaper frequently. "Bombers over Germany again last night . . . escorting Thunderbolts broke up mass attack by enemy fighters."

Possibly you missed an important point: *that most of these battles start at near-stratosphere levels, up around 35,000 feet or above.*

Thunderbolts patrol the *high* ways of today's air war, the strategically important stratosphere.

This very same stratosphere will be the natural sky-road for tomorrow's high speed, long distance transportation. We think of the Thunderbolt as the forerunner of great peacetime planes to come—planes designed for high speed, high altitude flight.

Republic Aviation will know how to build them! Republic Aviation Corporation, Farmingdale, L. I., New York.

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How Gunners Learn to Wing 'Em

Future fighter pilots and bomber gunners first practice "bead work," then get the knack of nailing moving targets with BB and skeet guns, finally polish their precision on real m.g.'s in the air.

MILITARY

BUILDING THE AAF
PART V

THE YOUTHS WHO YESTERDAY were plugging squirrels in Oklahoma, ducks in Louisiana—or even an odd tin can on a fence in some city or town—are today drawing the same fine beads with AAF fixed and flexible machine guns in every theater of action.

It's a long way from a .22 rifle in the woods to a .50 cal. m.g. in a *Flying Fortress*. But experience with a rifle often adds up to facility with a machine gun—particularly under the AAF's system of training.

For instance, they're mighty proud down at Eglin Field, Fla., that the staunchest admirers of the instruction courses in fixed gunnery are the pilots who've been in action.

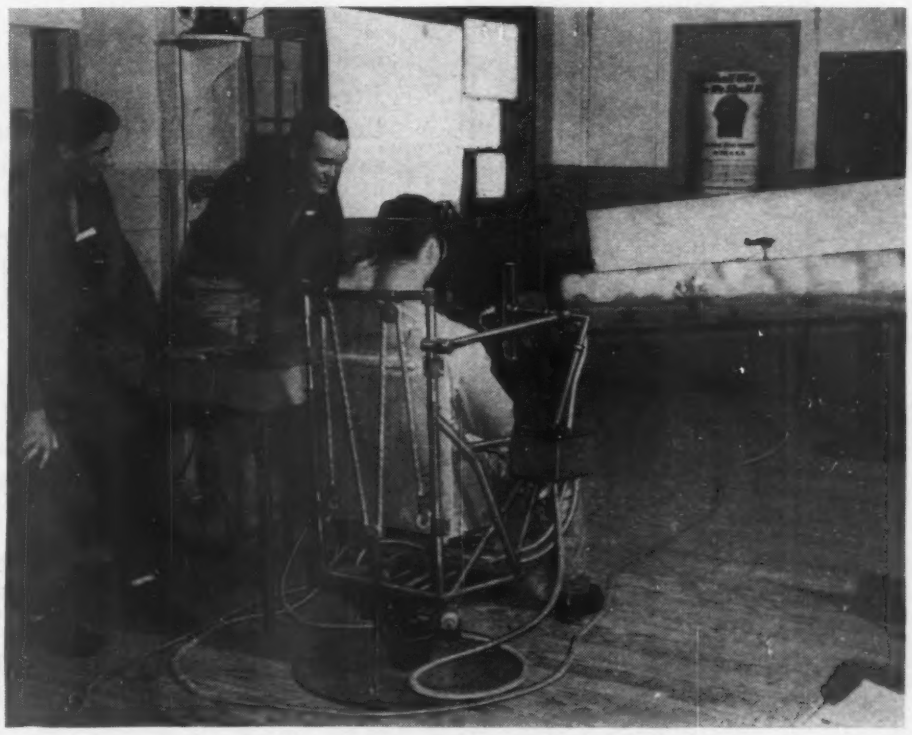
"Nothing's any good unless it's good in combat," says blond, mustached Capt. A. E. Hemming, Jr., youthful director of the training.

The gunnery men who established the AAF's first fixed gunnery school at Eglin have been ever-conscious of the need for close contact with ideas and techniques developed in action. Numerous innovations in firing the fixed guns mounted in the wings of fighters and medium bombers were developed by tireless study and experiment at Eglin. But others were transmitted from the war zones.

"After all," Capt. Hemming says, "There's no point in sending a plane up if its pilot can't shoot straight. We're trying to teach pilots to shoot like they'll have to in combat, so we're always on the lookout for the pertinent lessons picked up by our wide-awake fighters when they were mixing it with *Zeros* and *Messerschmitts*. Right now we know we have the world's most effective fixed gunnery training—but we're trying to improve it all the time".

Eglin, which is also a proving ground, is surrounded by seven self-sufficient auxiliary fields. Each has broad, long

Skeet shooting teaches fixed and flexible gunnery students importance of "leading" target.



Range estimation—from a regulation plane seat, cadet takes sights on model plane and judges its distance.

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  - Intercoolers
  - Air Ducts
  - Insulating Dissimilar Metals
  - Seaplane Floats

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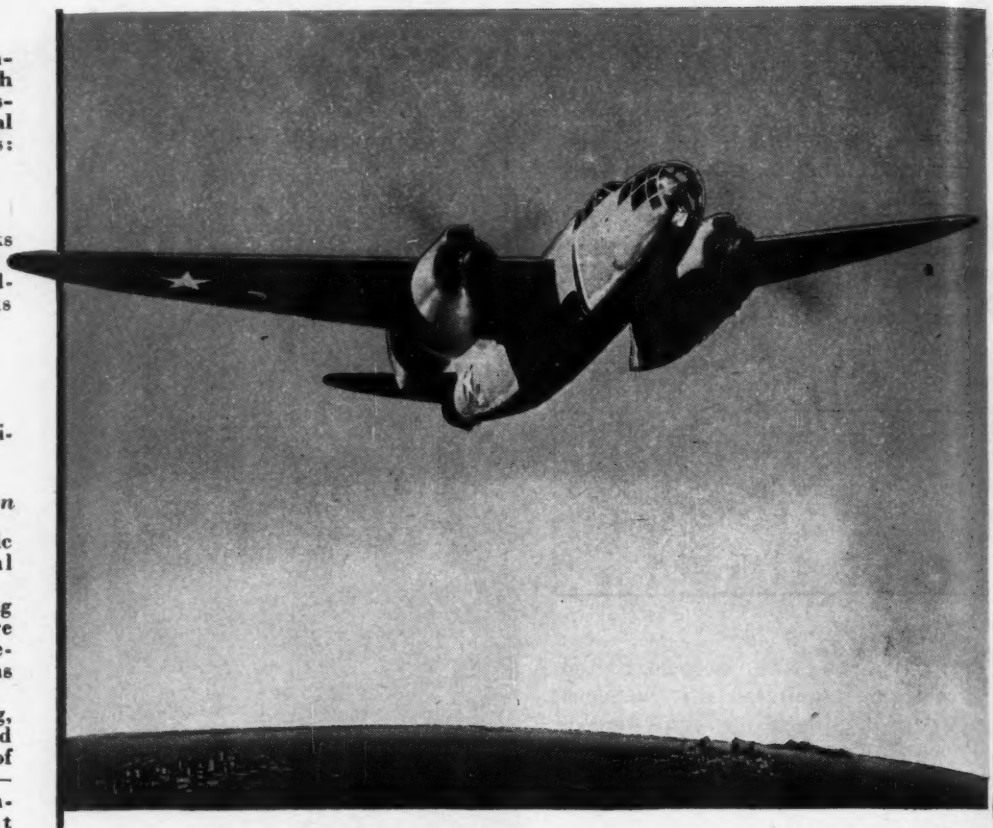

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runways, photo laboratory, post exchange, mess halls, and operations and administrative set-ups. The skies are filled from early until late with North American AT-6 trainers in which cadets fire on tow targets.

Most of the cadets are in the latter stages of advanced flight training. They have come to Eglin from the various single-engine schools within the Southeast Training Center.

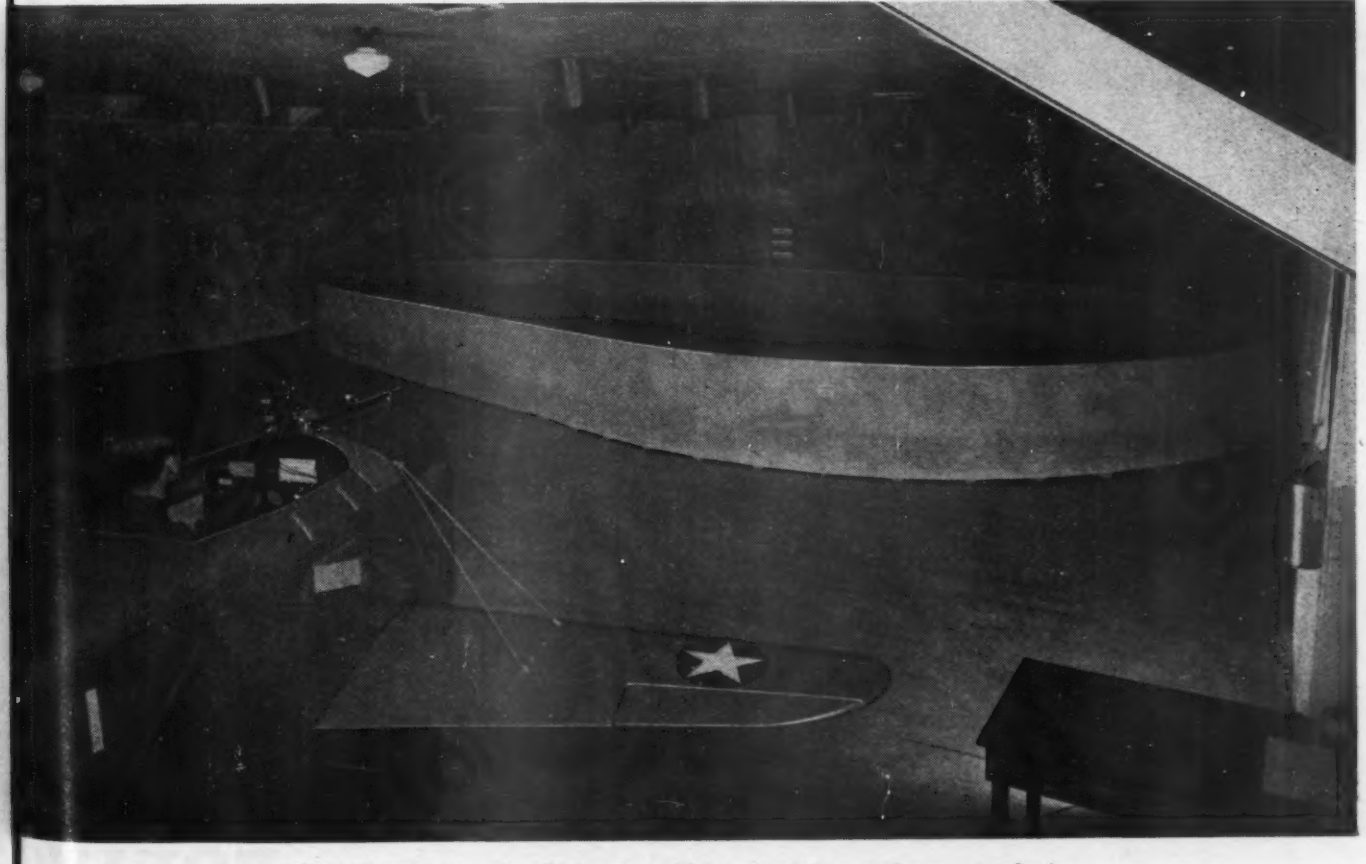
The shooting course lasts approximately eleven days. Each cadet contingent arrives with its own airplanes and instructors. When they report, students are novices at a deadly game—but when they leave they are equipped to join in with military aviation's finest aerial hunters.

Theory and Practice

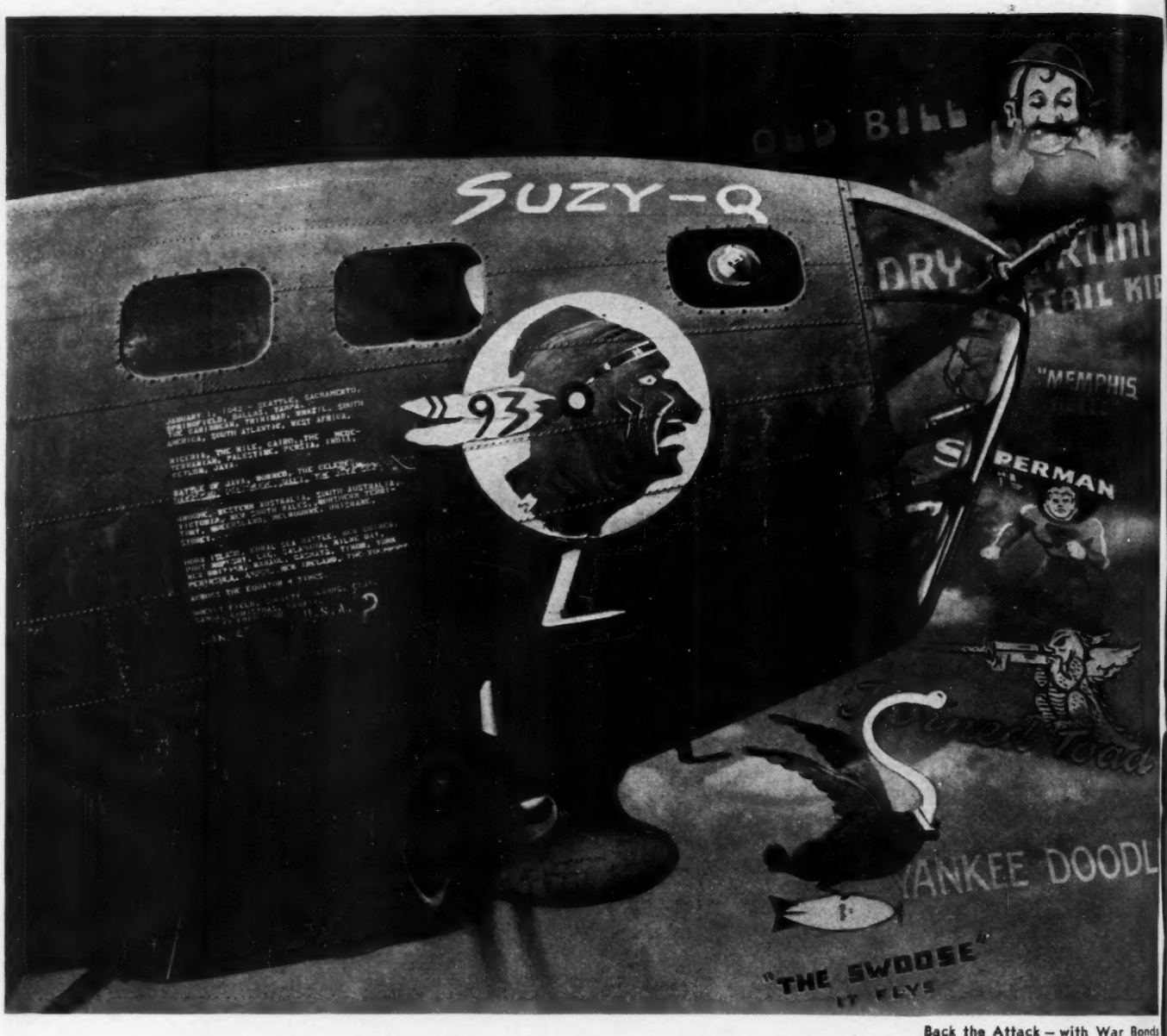
For five days after reporting to Eglin, cadets are occupied principally with ground school studies of theory and machine gun and sight maintenance and operation. During the six days they spend at one of the auxiliary fields, their time is filled with nothing but gunnery. First with an instructor and then alone, they take to the skies with loaded guns and head for a designated range. With five other planes in the range traffic pattern, they wheel and dive through 180-deg. attacks. Five or six runs on the towed target are made on each practice round aloft—the number depending on the amount of ammunition expended on each run. The target, a wire mesh rectangle 4x20 ft., is towed at 120 mph. while the attacking AT-6 comes in at approximately 160.

According to Lt. G. P. Charpie, operations officer at Auxiliary Field No. 2, the new student's most frequent error is to begin firing when he is still out of range, usually at 500 yd. Approximately 150 is the correct distance, giving the pilot time to fire a burst and then wing

Knowing how to knock down a gun and identify its parts is insurance for man who may have to make emergency repairs under fire.



With BB gun mounted on Link trainer (Hale trainer) future pilot practices leading, range estimation, and firing at targets which move around circular track.



Back the Attack — with War Bonds

Affection

As you read story after story about Boeing Flying Fortresses,* one thing is apt to impress you above all else . . . *and that is the deep-rooted affection which Fortress crews have for the sturdy ships which bring them back to their bases, time and again, from fierce battles with the enemy forces.*

Consider the case of the Fortress which fought off half a hundred Nazis for twenty minutes and then limped home with her left wing severely damaged, her inboard engine dead, and more than 2000 bullet holes in her tough hide. At the height of the action the skipper told his crew they could jump. "Sorry, sir," they called back over the interphone, "we're too busy shooting down Focke-Wulfs."

Or this, by another pilot: "We were traveling between 400 and 450 miles an hour. According to the slide rules, there was no chance of our pulling out of the dive. But we were goners if we didn't try. There were tearing noises; the bombs were crashing through the bottom. Then the Fortress came up level, and the wings were still with us! She's a great ship, and you know what I mean when I say GREAT!"

Back of stories like these, and the plane that inspires them, there *must* be designing and engineering and manufacturing skills of high degree. The Boeing engineering staff numbers over 3000 and includes men with experience in more than 25 distinct fields . . . structural, electrical, hydraulic, acoustical, metallurgical and many others.

Boeing products have consistently met or exceeded all claims made for them. True today, it will likewise be true tomorrow . . . if it's "Built by Boeing" it's bound to be good.

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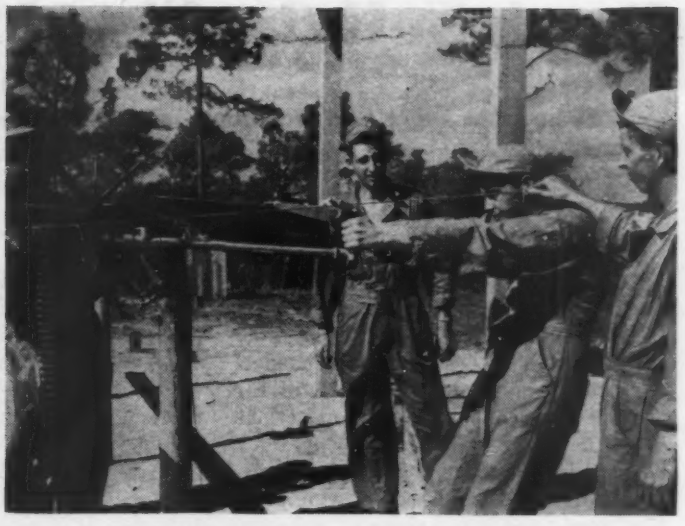
*THE TERMS "FLYING FORTRESS" AND "STRATOLINER" ARE REGISTERED BOEING TRADE-MARKS

Over Gulf of Mexico, student aims at towed target with .30 cal. machine gun specially rigged in back pit of North American AT-6.



Proper distance between eye and sight of flexible gun for correct shooting is measured off with a string.

away before colliding with the target. A target-and-plane mix-up is not unusual, but no injuries or crashes have resulted from such tangles.

When class in the skies is over, the tow plane flies low over the landing area and drops its target. Later, the score for each cadet may be determined by the color fringing the bullet holes in the target, since ammunition in each plane is colored differently. When firing at targets on the ground, the cadet may gage his accuracy by the dirt he kicks up.

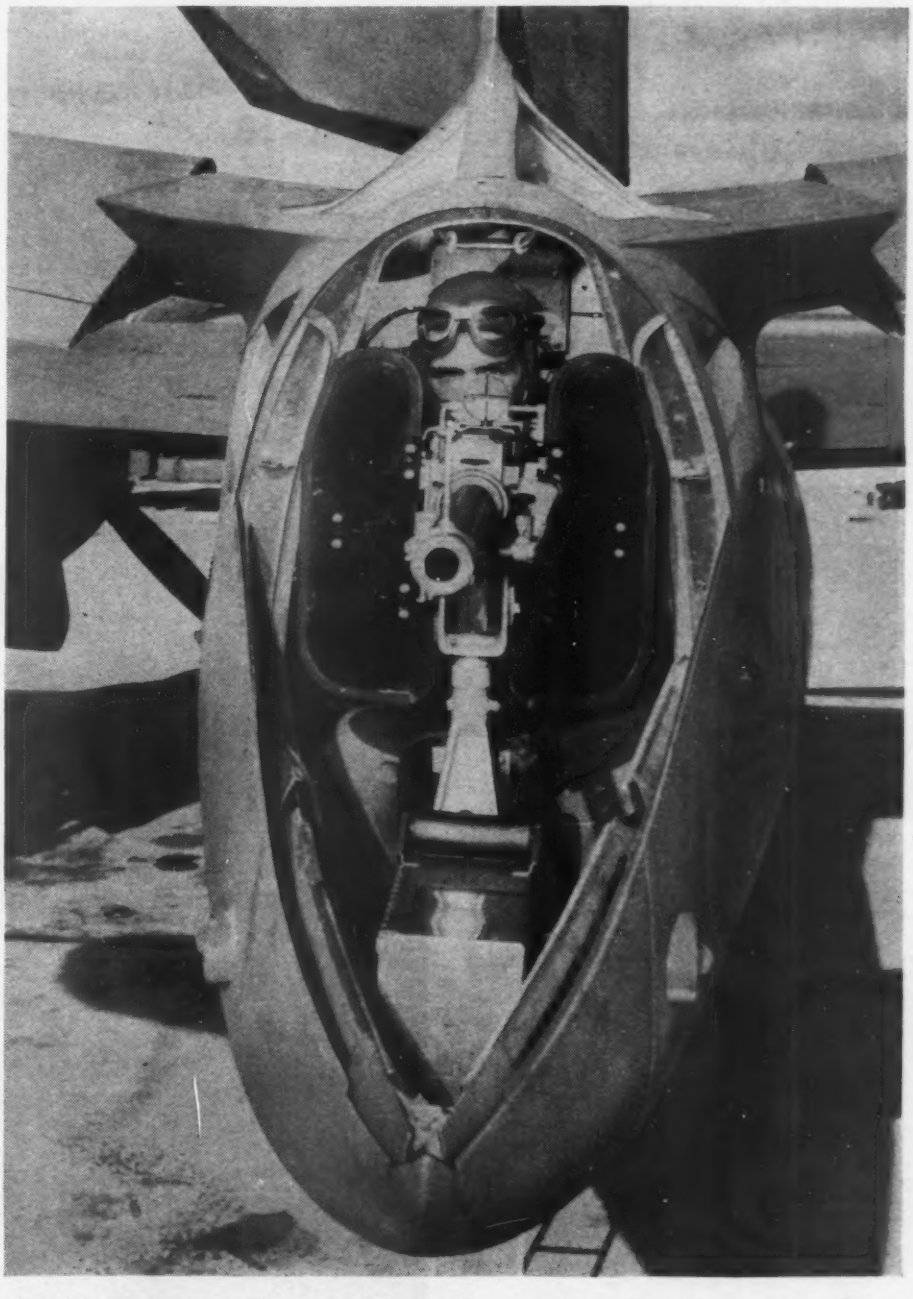
Faults in range estimation (the cadets get a thorough course in that at Eglin) and in judging relative lines of flight, in timing, and in "leading" are the most frequent errors encountered in training. However, when the cadet has fired a minimum of 1,300 rounds of ammunition for the course (and usually as many as 2,300 rounds) he has perfected the knack of spraying lead where he wants it.

The gunnery school officially began operations in 1941. Then cadets had an average of less than 1 percent of hits at the completion of their course. "Since that time, profiting from countless trial-and-error experiences and experiments," says Capt. Hemming, "we have perfected what we believe to be a significant efficiency of instruction."

(*Turn to page* 304)

ACCIDENTS DROP

Among the nearly 100,000 pilots being trained yearly by the AAF, the accident rate has dropped since Nov., 1942, although time spent in the air has nearly doubled, totaling 2,338,476 hr. this September. Percentage of present mishaps is not announced, but the number per thousand hours in the air has decreased from .045 in 1931 to .037 in 1942.



In B-26 tail turret student gunner takes sample aim before taking off for practice flight.

Don't Sell the Fixed Base Operator Short

. . . just because there's no war contract in his pocket. The adaptable "baseman" who knows the business isn't licked that easily. What's more, he can make money and project a future—as this case shows.

CAN FIXED BASE OPERATORS survive today without government contracts? Decidedly. In fact they can do better than that: They can make moderate profits and prepare themselves for continued—even expanded—operations after the Big Fuss is over.

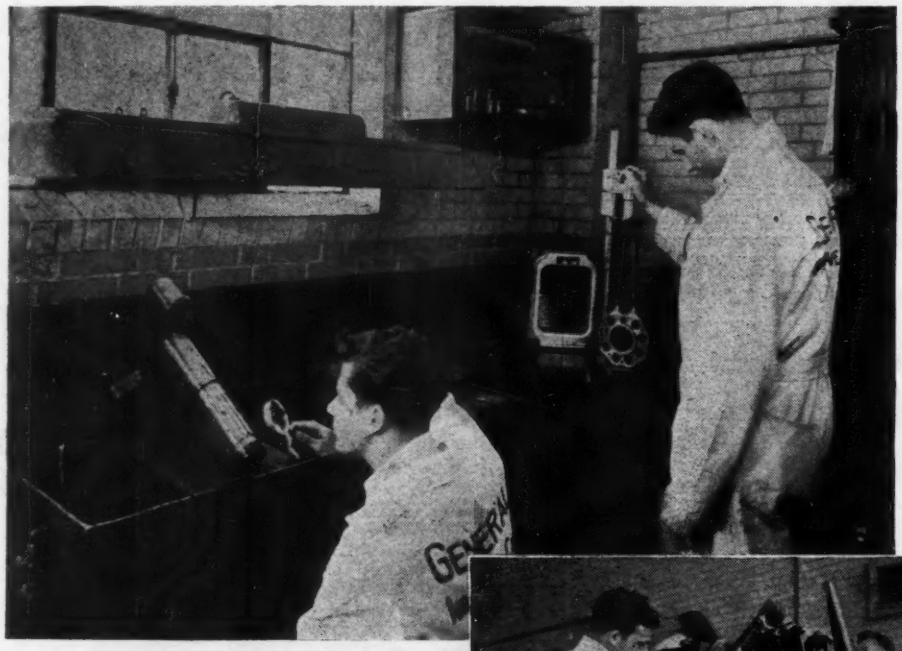
To maintain such a position does, however, require adaptability, a lot of plain hard work, and a full share of the courage which any fixed base operator must have at any time. For excellent example, consider the operation provided by General Airmotive Corp. (at Cleveland Municipal Airport) whose experience offers some significant "hows" to other operators, many of whom face curtailment of flight training programs.

General Airmotive, organized in 1934 as a sales and service organization, immediately acquired a franchise for distribution of Wright engines, a franchise still held. The line was soon broadened to include Scintilla magnetos, Stromberg carburetors, BG, Bendix and Champion spark plugs, Eclipse starters, American Hammered piston rings, Packard Electric cable products, and, later, Lycoming engines and Sensenich Propellers.

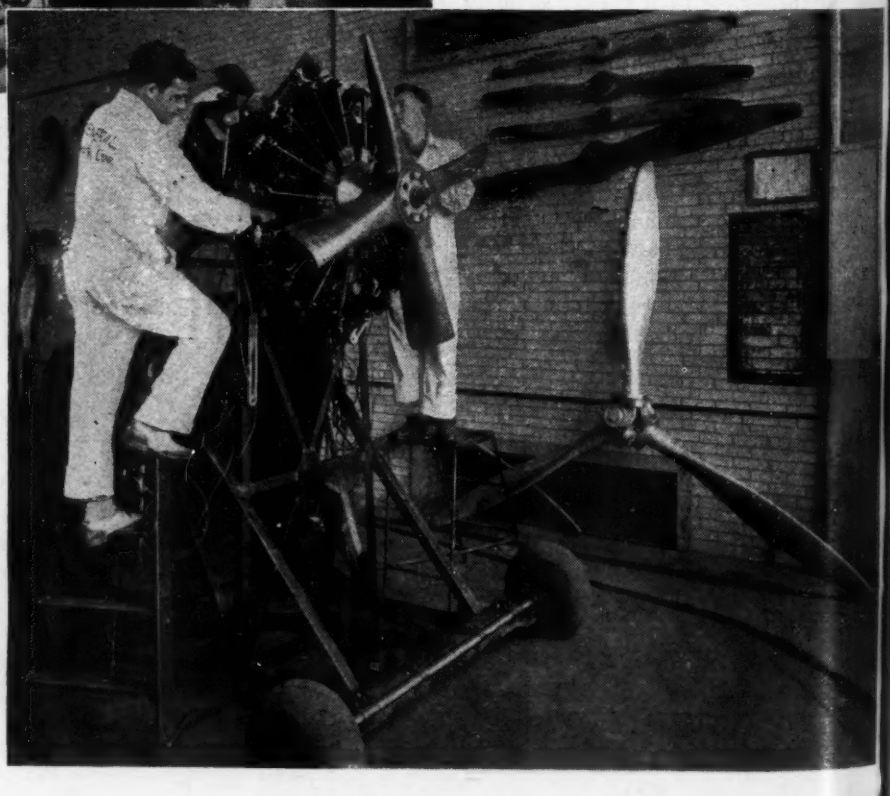
Today, General Airmotive holds Government Certificate No. 272 for overhaul of composite and metal aircraft, engines, and metal and wood propellers. As a result of its steady expansion of facilities and services for private owners in the Great Lakes region, it boasts the most complete airplane and engine overhaul base between New York and Chicago.

It has always been a policy—almost a fetish—of Airmotive's Pres. J. W. Borton to maintain the largest possible inventory of the complete line. This policy has stood the firm in good stead throughout its career, first because it gave the organization a reputation for ability to supply other operators with the parts they needed precisely when they were needed and, more recently, for ability to supply customers when all other sources had failed.

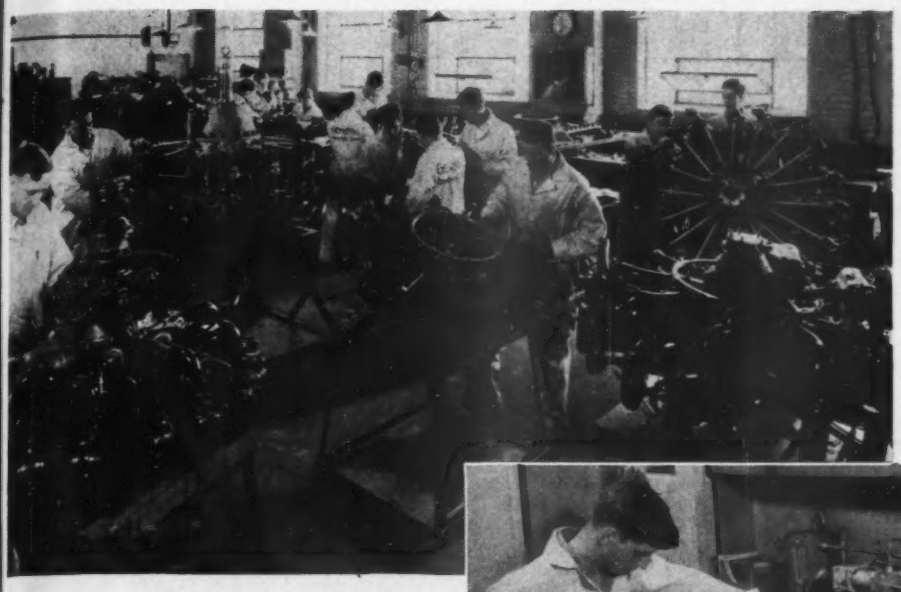
Not long ago, for instance, a Toledo manufacturing company which needed a special type of rivet in an emergency sent a plane to pick up the order. Other cases: Two Akron rubber companies that ran short of necessary cable and elastic nuts found them at Airmotive; a Cleveland aircraft plant which needed a timing disk located it at GAC; and a Cleveland aeronautical research laboratory was able to borrow special equip-



Success of General Airmotive's fixed base operations without government contracts has been due in large measure to wide line of products for sale coupled with ability to render specialized as well as general overhaul and maintenance service. Specialized service, in turn, has been greatly aided by addition of most modern equipment possible, such as this Magnaflux unit, first to go in operation in the firm's territory.



Engines coming from government-approved overhaul shop get run-ins on adjustable stand designed and built by GAC personnel. Wide variety of engine sizes and types can be handled through use of adjustable slot attaching points.



CIVIL OPERATION AND TRAINING

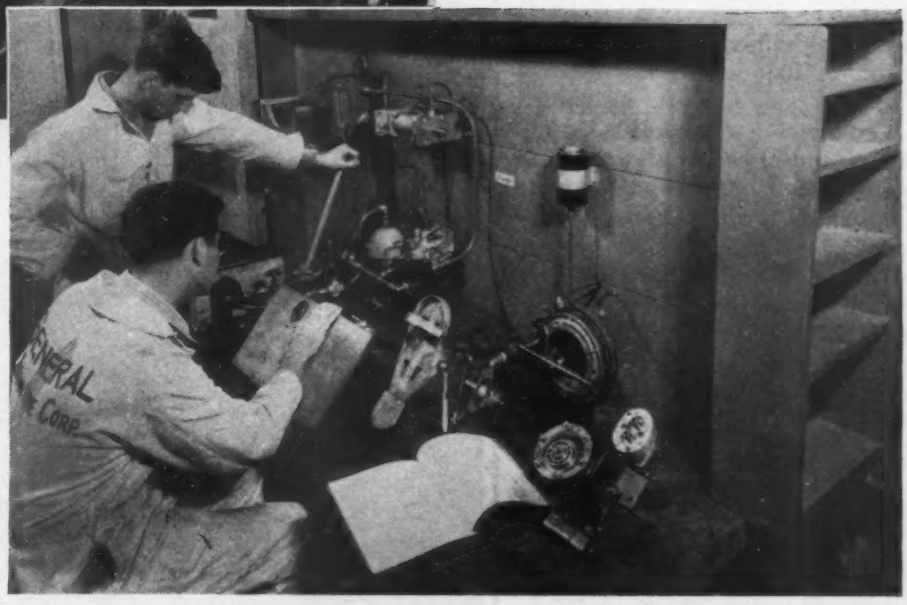
Students in company school spend 20 percent of time in classroom; remaining 80 percent in practical work on company-owned engines, ranging from 40 to 1,000 hp. GAC employees are selected from students, so some of these men may later service engines sold by firm, which is broadening line to be handled in postwar era.

ment that was necessary for an important experiment.

This type of operation has also given the firm a more or less official reputation as a jobber so that, if conditions in the future should warrant any change in this direction, they can easily be made, the "spade work" already having been done.

In keeping with the idea of large inventories and a wide range of products

(*Turn to page* 299)



Students study hydraulic theory and practice on test equipment built in GAC shops. More than 500 graduates and former students of school are in armed forces, and record shows 98 percent of graduates have passed CAA license examinations. Company's postwar emphasis will again be on sales and service of engines and accessories.

CAP Fairchild gets final check at GAC before taking to air after overhaul based on "airline standards for private aircraft owner." Company did service work for airlines early in its career; same may be done for feeder lines in postwar period.

WHY IS

Tego Resin Film

THE STANDARD AIRCRAFT PLYWOOD ADHESIVE?

THE introduction of TEGO Resin Film in 1935 changed entirely the concepts of aircraft designers and engineers concerning the qualities and uses of plywood in airplanes.

A phenol formaldehyde resin adhesive supplied in sheet form, TEGO made possible plywood having such improved service characteristics that TEGO-BONDED plywood became overnight an important structural material. In addition to giving unexcelled durability, TEGO Resin Film made plywood boil-proof, water-proof, weather-proof and fungus-proof. TEGO also revolutionized the manufacture of plywood—made possible the development of mass production methods.

That is why today TEGO Resin Film is the accepted standard in the manufacture of plywood not only for airplanes and airplane subassemblies but for PT boats, landing barges, Army truck bodies and prefabricated houses.

When interleaved with veneers of fine woods, then hot pressed, TEGO Resin Film forms panels which meet rigid Army and Navy Specifications for aeronautical plywood.

The Complete Line of Resin Adhesives

TEGO RESIN FILM, for hot-pressed plywood, produces the most durable plywood known, fully meet the requirements of Army-Navy Aeronautical Specification AN-NN-P-511-B.

AMBERLITE PR-14 is widely employed for rubber bag molded plywood filling the need for a powdered phenolic resin adhesive which possesses extreme water resistance and durability.

UFORMITE CB-551, a pioneer cold-setting urea formaldehyde resin complies in all respects with Army-Navy Aeronautical Specification AN-G-8, has proved an ideal bonding agent in assembling plywood aircraft sections.

UFORMITE 430 AND UFORMITE 500, for either hot-pressed or cold-setting plywood, give remarkably strong bond at relatively low cost.

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

On Patrol

• Airplane fabric and tape have been listed by WPB on first quarter 1944 repair parts applications, and distributors are being designated. Civil Air Patrol National Headquarters is informed that procedure is also being evolved for distribution of parachutes and parts.

• While CAP 2nd Air Force Courier completed 97 percent of its flights during the summer, headquarters warns that attempts to maintain such records in winter weather are foolish and may be fatal. "Unless it's a life-or-death mission—and few are as important as that—a flight with weather stacked against it is one to cancel. For a half-skilled pilot in an old klunker of a ship to give a look at the sky and take off over the hills is not heroism. It's just damned foolishness."

• St. Louis Women's Advertising Club has given the local squadron two Piper *Cubs* and an *Aeronca* for training members and cadets, who will have to pay only half the usual fees.

• Capt. Frank I. Adams is new communications officer at New York CAP headquarters.

• Otherwise qualified applicants who have been citizens of this country or the Philippines not less than ten years are now eligible for membership. Birth in Axis countries no longer excludes persons naturalized at least ten years.

• Practice hand grenades have been used by CAP flyers to scare ducks which have been desecrating California rice fields. When the ducks take wing, planes fly above them and shoo them to Wildlife Service feeding areas. Since the ducks can do 60 mph., flyers must keep on the *qui vive*.

• Indiana state guardsmen, returned from maneuvers with CAP, report that the pilots' good aim with flour bags resulted in hits on marching columns, trucks, and—alas—a cook tent.

Along the Apron

• Women graduates of the Ferry Command are now being taught to fly and maintain Boeing *Flying Fortresses*. The first 17 grads are practicing in Ohio.

• Thirty-one schools were used by Goodyear Aircraft to train new workers in a three-year expansion from 300 to 35,000. Percentage of women, already large, is expected to increase.

• More than 100 instructors and staff members of Embry-Riddle School of Aviation have left for Brazil to establish a school for training technical specialists. Following six-months' study, native students will be assigned positions by the Brazilian Air ministry for which the school is being run. By Christmas, 500 candidates are expected to be in training.

• Meanwhile, nearly all Brazilians who were studying in this country under the Inter-American Aviation Training Program (sponsored by CAA, AAF, and five other American organizations) have already been called home for military service. All but 11 of 351 students from other countries have graduated from four technical courses. Of 106 remaining here, 92 are engaged in aviation work. Out of another 259 pilot trainees, 168 have graduated. This is an average comparable to that established by American cadets.

• Summary of teaching courses, desirable curricula, and extent of present courses has been prepared by CAA in bulletin, *Education for the Air Age*. It points out that "ultimate adjustment of schools involves a clear recognition of the dual nature of the problem: The

CIVIL OPERATION AND TRAINING

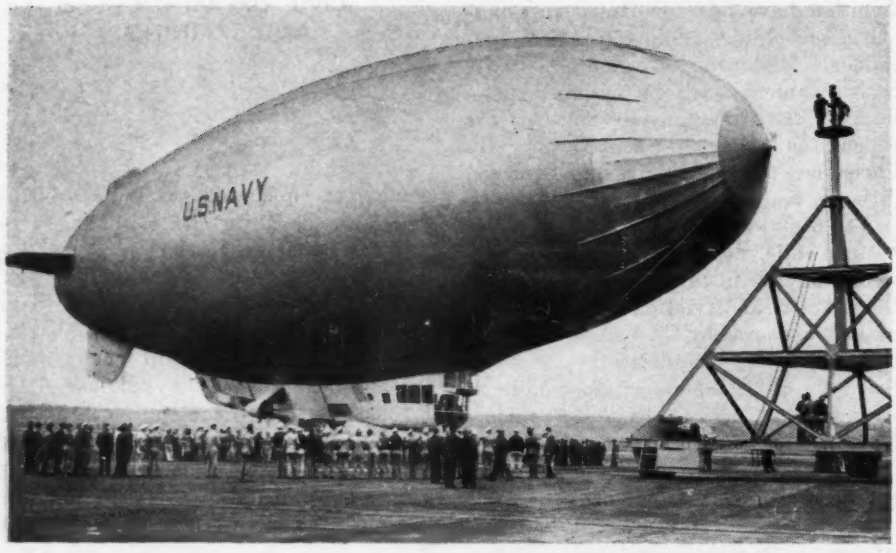
immediate effects of swift transportation, and the adjustments in society to be worked out over a longer period."

• "The breast-stroke, punctuated with preliminary splashings at the beginning of each stroke, will cut a path through the flames," explains AAF Flight Control Command in booklet, *Swimming Through Fire*. "Keep your mouth close to the water and duck your head every third or fourth stroke."

• New Courses: University of California Extension Div., "Work Simplification and Time Study", also training in avigation; Columbia University School of Engineering, advanced studies in various subjects for practicing engineers; Massachusetts Dept. of Education, pre-induction courses in aviation mathematics and camouflage, plus others in engines, structures and rigging, instruments, meteorology, and avigation.

FLYING SERVICE MAN

At controls of his 4-place Cessna, Edward M. Goemans, president of Transit Bus Sales, Milwaukee, covers territory from Lake Michigan to Denver in which he is a distributor for Ford buses. Occasionally he makes special flights with replacement parts for buses which are "down" on road.



M-1, newest and largest non-rigid airship built for Navy by Goodyear Aircraft Corp., begins test flight at Akron, Ohio. Half again as large as present anti-submarine patrol blimps, M-1 has greater cruising range and bomb-carrying capacity as well as additional gun mountings.

FLYING EQUIPMENT

Goodyear M-1 Blimp Begins Test Flights

Featuring novel three-section control car, new craft has 50 percent greater capacity and more range than predecessors.

UNDERGOING TEST FLIGHTS is the new M-1 "super-blimp" of 650,000 cu. ft. gas capacity. Built by Goodyear Aircraft Corp., it brings to four the number of types now being operated by the Navy.

Although the M-1's 290-ft. length is only some 40 ft. longer than the K-ships now being used on coastal patrol work, it has 50 percent greater helium capacity, which gives a substantial increase in cruising range and load. While no performance figures have been released by the Navy, the M-1 is reported to be faster than the K-type blimp.

Principal difference between the two craft is in the operating car. In the M-1 the car is three times as long as that in the older blimp. This new car is built in three connecting units which are integrated by universal joints to allow freedom of motion in coordination with the flexible gas envelope. A blister for machine gun mounting and wider observation is attached to the bottom of the mid-section of the car, on which are also mounted outriggers carrying two Pratt & Whitney *Wasps*. The M-1 craft is even larger than the Army's semi-rigid RS-1 built in 1924. Its 650,000 cu. ft. gas capacity compares with other Navy blimps as follows: L-type trainers, 123,000 cu. ft.; G-type trainers, 196,000; and K-type coastal patrol and escort ships, 425,000 cu. ft.

"TEEPEE AIRACOBRA" MAKES DEBUT

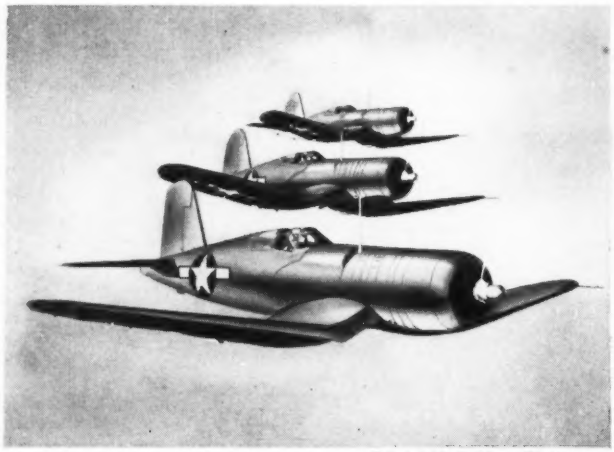
Bell TP-39 *Airacobra* (the "T" stands for two-place) developed for transition training. While not the first modification to provide instructor's seat in fighter craft, "Teepee" differs in that full extra set of controls and simplified instrument panel are included. Since engine is located just aft of pilot's cabin, extra seat had to be placed forward, which required removal of 37 mm. cannon, fuselage machine guns, and cowling. To maintain directional stability with extended cabin, dorsal fin was enlarged and small auxiliary fin was attached to fuselage bottom. Trainer model is interchangeable with production P-39, which can be transformed to trainer by installation of special kit of parts which can be made up and shipped anywhere. Photo at left shows special insignia developed for TP version.

THE NAVY NEEDED LIGHTER, STRONGER TIRES...

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

Heavier, Faster Navy Planes Demanded Lighter, Stronger Tires

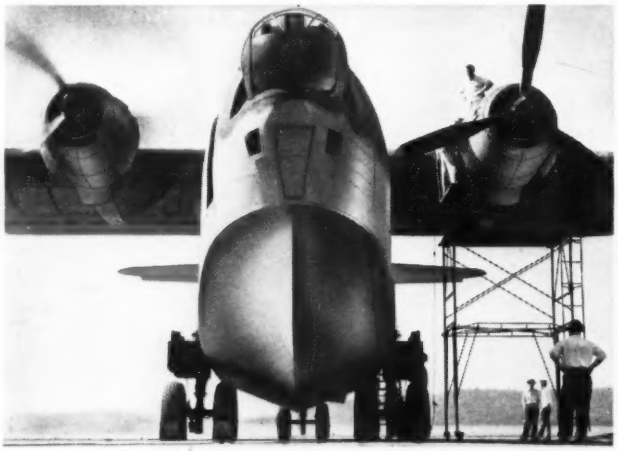


Official U S Navy Photograph

FIVE AND A HALF TONS of speed and fighting power hit a carrier's deck when the Vought Corsair lands. Tires have to take the "sock" of flight deck landing with minimum rebound, stand the high brake temperature of fast stops and track straight without dangerous skidding.

Official U S Navy Photograph

THE WHOLE WORLD IS HOME to the Consolidated Catalina. It roves the sea and land, may come down for a landing on sandy beaches, jungle landing strips, steel mats or concrete runways. Every ounce of weight counts. With cruising range of over 4000 miles, the tires of this giant amphibian must be light and strong.



FLYING BOATS NEED TIRES, TOO! At their bases, the big Navy flying boats must be beached for service and maintenance. Tires for beaching gear must be able to carry their great weight—are equipped with special valves so the gear can be applied under water.

"U. S." FIELD AIRPLANE TIRE ENGINEERS spend much of their time not only working with makers of Navy planes but also at Navy flying bases helping to work out tire problems wherever they are found. Airplane tire conservation and maintenance is an important part of their job.

Every Navy plane, from fast shipboard fighter to long-range patrol bomber has its own specialized tire problems. With weight of armor, fuel and ammunition load, speed, range and fire-power greatly increased, tires have to shoulder greater and greater loads. And every ounce of weight must mean more fighting power. The Navy needed lighter, stronger tires for its heavier, faster planes. This is the story of how those tires were built.

1230 SIXTH AVENUE **UNITED STATES**

From cotton to rayon to nylon has been the history of development of tires for military aircraft as airplane speeds and loads have been increased. "U. S." airplane tire engineers pioneered the rayon cord tire that cut down over-all weight and bulk without losing an ounce of the strength needed to support the increased load. Today rayon cord tires are the standard of the Service.

But tires of even greater strength and reduced weight were needed especially for heavy bombers. Over-all size could not be increased. Again it was a problem for the airplane tire engineers. Drawing on their experience with rayon cords, they developed a new tire built with nylon. Weight was reduced 16% from cotton cord tires and strength increased 64%! Today these giant Nylons are serving on Navy planes under the toughest landing and take-off conditions...they point the way to even stronger, lighter, better tires for the war planes and the peace planes of the future.

THE SHIPS ON THE COVER AND THE TIRE SIZES THEY USE

PLANE	MAIN WHEEL TIRE SIZE	TAIL WHEEL TIRE SIZE	PLANE	MAIN WHEEL TIRE SIZE	TAIL WHEEL TIRE SIZE
1 Consolidated "Catalina" PBY Amphibian—Scout Bomber	47" 10-ply Smooth Contour	30.00 Smooth Contour	6 Curtiss "Seagull" SO-3C Scout Observation Seaplane & Landplane	26x6 8-ply High Pressure	8.50 Solid or Channel
2 Douglas "Dauntless" SBD Scout Dive-Bomber	30x7 8-ply High Pressure	6x3½ Solid or Channel	7 Grumman "Avenger" TBF Torpedo Bomber	34x9 8-ply High Pressure	10x4 Solid or Channel Tread
3 Grumman J47 Coast Guard Amphibian	32x6 8-ply High Pressure	12.50 6-ply Smooth Contour	8 Brewster "Buccaneer" SB-2A Dive-Bomber	32x8 10-ply High Pressure	8½x4 Solid or Channel
4 Curtiss "Helldiver" Scout Dive-Bomber	Not Released	Not Released	9 Grumman "Hellcat" F6F Navy Fighter	Not Released	Not Released
5 Vought "Corsair" F4U Navy Fighter	32x8 8-ply High Pressure	8½x4 Solid or Channel	10 Vega "Ventura" Patrol Bomber	16.00-16 10-ply Low Pressure	18.00 6-ply Smooth Contour

RUBBER COMPANY ROCKEFELLER CENTER, NEW YORK 20

NAVY FLIERS "Hit the Deck" on these U. S. Royal Airplane Tires

Official U. S. Navy Photograph

U. S. ROYAL
High Pressure Block Tread
For carrier landings and take-offs, the U.S Royal High Pressure Block Tread gives low rebound and positive traction

U. S. ROYAL
Smooth Contour Block Tread
The tough, sharp edges of the U S Royal Block Tread protect against either forward or lateral skids.

U. S. ROYAL
High Pressure Channel Tread
This new tire with wide, flat tread combines minimum bounce with pneumatic-tire cushioning. Available for tail and landing wheels.

Carrier-based planes must have tires that can take the toughest kind of service. They must absorb the shock of deck landings and hold the plane under control with minimum bounce. They must give sure traction on the carrier's deck or on the rough landing strip of an island outpost. U.S. Royal Airplane Tires are "hitting the decks" day after day... and coming back for more. Whatever your airplane tire requirements may be, there is a U.S. Royal Airplane Tire, with the new Static Conducting Construction, built to do the job.

UNITED STATES RUBBER COMPANY

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ENGINEERING DATA

Pipe, Tube Bending 1

Copper & Brass Research Assn., New York City, has issued 80-page illustrated book on methods of hot and cold bending of copper and alloy pipes and tubes including use of mandrels and such fillers as sand, resin, salt, and low-temperature melting alloys. Other information given includes unit weights of tubes of different alloys and various diameters, wall thickness, and shapes and data on chemical and physical properties.

Lathes 2

Engineering data book, prepared by Foster Div., International Machine Tool Corp., Elkhart, Ind., contains descriptions and specifications of standard and special tools for company's turret and platen lathes. Drawings and dimensions are provided for mechanics and engineers engaged in parts production.

Slide Chart 3

Elemoto Sales Co., Teaneck, N. J., issues folder picturing and describing its slide chart for obtaining standard dimensions from 0 to 1¼ in. for coarse and fine threads, for standard pipe threads, and for converting from millimeters to inches.

Metal Finishing 4

Folders and technical data sheets from American Chemical Paint Co., Ambler, Pa., picture and describe uses and method of applying company's "deoxidine" for preparing metal surfaces for painting, "kemick" paint for hot surfaces such as engine parts, "lithoform" for making paint adhere to galvanized and other zinc surfaces, and "rodine" for more efficient pickling of steel.

Hydraulic Fittings 5

Engineering drawings, part and tube numbers, dimensions and thread sizes of hydraulic fittings in AAF, AN, and NAF series are compiled in ring-bound booklet issued by American Screw Products, Los Angeles.

Steel Welding 6

Striking colored illustrations and photographs are contained in booklet titled *Welding Stainless Steels*, which covers effects of heat, metallic arc, atomic hydrogen, oxygen-acetylene, and electric resistance welding, and general information on welding pluramelt steels. It is distributed by Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Tooling Service 7

Complete aircraft tooling service, which its staff of 300 has supplied for production of new models by several manufacturers, is described in bulletin by Atlas Tool & Designing Co., Philadelphia. Services offered cover executive and engineering consultation, production engineering design and blue printing, manufacture of tools, dies, jigs, and special machinery, with follow-through supervision.

NE Steels 8

Components, characteristics, and specifications of National Emergency Steels are given in tables, illustrations, and text in booklet prepared by Republic Steel Corp., Cleveland.

Pulleys 9

Blueprints, photos, and engineering information on the use of its pulleys in various types of machine drives are contained in bulletin issued by Speedmaster Co., Des Plaines, Ill.

Plywood Specifications 10

Government Specifications for Plywood and Adhesives, available through Resinous Products & Chemical Co., Philadelphia, gives adhesives requirements, test procedure, and adhesives recommended in 27 specifications classified under the basic specifications of cold-setting resin glue, plywood and veneer (aircraft flat panel), hardwood and eastern red cedar plywood, and Douglas fir plywood.

Die Designing 11

Reprint of engineering article on *Factors to be Considered When Designing Die-Castings* is being distributed by New Jersey Zinc Co., New York City. It presents an analysis of suitable materials and suggestions on their fabrication.

PRODUCTION

Welding Hints 12

Current issue of *Oxy-Acetylene Tips*, published by Linde Air Products Co., New York City, contains articles on saving welding rod stubs, preventing worker injuries and avoiding fatigue, prolonging life of cutting regulators, and tabulations of recommendations for gas welding of various metals.

Lignum-Vitae 13

Examples of wartime uses of lignum-vitae in industry are given in bulletin from Lignum-Vitae Products Corp., Jersey City, N. J.

Glues 14

Use of waterproof glues in aircraft construction and descriptions of binders made by I. F. Laucks, Inc., Seattle, to meet government specifications are listed in illustrated brochure which also contains a section on wood preservatives.

Hardening, Pressing 15

Hydraulic Machinery, Inc., Detroit, has compiled in bulletins SM 843 and PT 845 information and illustrations of its equipment for flame hardening, hydraulic press

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13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
49 50 51

NEW PRODUCTS: 52 53 54 55 56 57 58 59 60 61 62 63 64
65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109

NAME.....TITLE.....

FIRM OR AFFILIATION.....

ADDRESS.....

work, molding, bending, broaching, two-way drilling, piercing, and spot facing.

Hose Couplers 16

Features of "Snap-Tite" hose couplers reported by Snap-Tite Coupler Co., Erie, Pa., are threadless connection that can be made with a twist of the wrist, swivel ball bearing to prevent kinks, and packing designed for various types of service. Specifications of models provided for steam, air, water, oil, and grease lines are listed in folder.

Small Parts 17

Its facilities for producing small parts and accessories for aircraft—among them clips and clamps, manual control assemblies, fork and rod ends, and small stampings—are described in booklet issued by Hyland Machine Co., Dayton, Ohio.

Tubing 18

Aircraft Tubing Manual shows various fittings manufactured by Tubing Seal-Cap, Inc., Los Angeles, describes types of tubing and fittings in use, how to obtain proper torque, and a list of points to be remembered in installing tubing.

Weld Shop Fire Reduction 19

Preventing Welding and Cutting Fires, pocket-size booklet prepared by International Acetylene Assn., New York City, gives foremen and operators practical information on causes and reduction of fires.

Greases 20

What Makes a Grease, booklet offered by Sun Oil Co., Philadelphia, discusses standards for judging types of greases, factors which should control selection, and types manufactured and consulting service offered by company.

MACHINERY & ACCESSORIES

Grinding Wheels 21

Tool and cutter and surfacing recommendations for various wheels and grinding materials produced by Bay State Abrasive Products Co., Westboro, Mass., are given in illustrated folder published by company.

Abrasives 22

Minnesota Mining & Mfg. Co., St. Paul, issues manual, *3-M Abrasive Specialty Items*, picturing its line of shapes and forms for grinding and finishing metals.

Handling Equipment 23

Circular No 134 presents line of hydraulic lift, pallet, die handling, hoisting, and sheet handling trucks, hydraulic hand- and foot-operated pumps, and aircraft production and servicing equipment manufactured by Lyon-Raymond Corp., Greene, N. Y.

Portable Cleaners 24

Broadside prepared by L & R Mfg. Co., Newark, N. J., illustrates portable machine for cleaning, rinsing, polishing, and drying small precision parts.

Anti-Corrosion Wrapper 25

"Induwrap," material for wrapping highly finished steel and other metal parts consists of four plys: Kraft paper, sheet of cellulose acetate to retain protective oil film, a binder (to unite the inner material to the outer layers), and a 30-lb. neutral sulphate kraft sheet which inhibits corrosion. Sulphate sheet is slightly corrugated to give channels through which moisture may evaporate. It is made by Angier Corp., Framingham, Mass.

Alloy Tools 26

Catalog No. 227 on "Tantung" tools—trade name for non-ferrous cast alloy for metal cutting between grades now obtained with high speed steel and cemented carbides—lists sizes available and prices on solid tool bits, cut-off and milling cutter blades, shell and solid end mills, and boring and form tools. Also given by manufacturer, Vascoloy-Ramet Corp., North Chicago, are performance and screw machine data and information on grinding and brazing.

Agitators 27

Pictures, prices, and descriptions of various types of air-motor agitators for mixing liquids, such as engine oils, are contained in bulletin, *Pneumix in Action*, prepared by Eclipse Air Brush Co., Newark, N. J.

Record Reproduction 28

Copying of office and shop records, engineering diagrams, and blue prints is said to be possible without need of darkroom, camera, or focusing with machine developed by Hunter Electro-Copyist, Inc., Syracuse, N. Y. Various models of reproducers, with specifications and accessories, are shown in bulletin prepared by the company.

Rotameters 29

Catalog section 13-D, offered by Fischer & Porter Co., Hatboro, Pa., shows new rotameter instrument panels for testing and control in flow rate instruments and other models for low-capacity service.

Work Light 30

Designed by Diehl Mfg. Co., Somerville, N. J., new work light for use in inspection, assembly, sorting, and precision machine work has blue-tinted lens and 6-8 v. bulb connected to regular voltage circuit through a transformer. Applications and other features are shown in bulletin No. 2031 from company.

Testers 31

Described and illustrated in 48-page catalog prepared by Televiso Products, Chicago, are various models of test apparatus to check aircraft gyros, vibration, and electric and mechanical laboratory and production work

Die Set 32

Improved "link pivot" to absorb stresses on its aligning spring has been added to self-balancing die set manufactured by Leslie Welding Co., Chicago. Engineering drawings and text in folder show its uses and principles of operation.

Precision Cutting 33

Picture story in booklet prepared by The Doall Co., Des Plaines, Ill., shows war production jobs on which its various machines for precision band sawing, band filing, and polishing have been used.

Wrench Catalog 34

Glossary of terms for new workers is contained in catalog No. 243 of Blackhawk Mfg. Co., Millwaukee. It also gives list of wrenches now available and suggestions of types for particular production jobs.

Precisioning Equipment 35

New edition of Catalog No. 836, Challenge Machinery Co., Grand Haven, Mich., contains illustrations, descriptions, and specifications of company's equipment for precision work, including layout surface plates, reading, checking, and turn tables, work benches, bench and lapping plates, straight edges, angle irons and plates, solid and box parallels, and V-blocks.

Parts Finishing Machines 36

Machine tools for drilling, reaming, chamfering and other production operations on various parts of aircraft engines, are pictured and described in Vol. 18, No. 4 of *Tool Tips*, bulletin issued by Ex-Cell-O Corp, Detroit.

Cleaners 37

Various types and sizes of machines for cleaning, pickling, and washing metal parts, chip processing, tumbling, and burnishing are shown in 32-page catalog distributed by Howard Engineering & Mfg. Co., Cincinnati.

Diamond Tools 38

Wheels, saw blades, core bits, and other diamond-pointed tools marketed by Champion Diamond Co, New York City, are pictured in folder which gives their specifications and prices

Identification Printers 39

York Electric and Machine Co, York, Pa., has prepared two folders showing the features and operating principles of its hot stamp printer for marking wire from No. 0 to No. 22 and of its scotch tape marker. Identification printing type is easily changed in both machines, and the hot stamp model can be adjusted to mark on from 3 to 12 in. centers.

Micrometers 40

Readings to 1/10,000 in. are reported possible on micrometers up to 3-in. capacity. Bulletin showing models in Reed 800 series has been issued by George Scherr Co, New York City.

Finishing Machinery 41

Bulletin No. 401 has been prepared by Hammond Machinery Builders, Kalamazoo, Mich., to show engine and machine parts which can be automatically deburred, brushed, polished, or buffed on several models of its machines. Table of specifications gives capacities of six and eight work-spindle models.

AIRCRAFT ACCESSORIES

Brake Servicing 42

Barrett Equipment Co., St. Louis, has prepared folder showing details of its model B-117 machine for servicing brake shoes and adjusting them to drum size.

Insignia 43

Bulletin prepared by Di-Noc Mfg. Co., Cleveland, deals with its prefabricated film insignia for aircraft identification and the marking of operating instructions on various controls. Given is brief resume of specifications and method of applying the insignia, which are said to stand bending over ⅛ in. rod without fracturing.

Starters 44

Installation and advantages of light weight kick type starters for use on small planes are given in folder from McDowell Mfg. Co., Pittsburgh.

To Curb Fires.....45

Use of carbon dioxide as a fire extinguisher in aircraft is illustrated in current edition of *High Pressure*, publication of Walter Kidde & Co., New York City.

ELECTRICAL

Motors 46

Material on power issued by General Electric Co., Schenectady, N. Y., includes *Motor Fitness Manual*, 40-page booklet of engineering suggestions on efficient installation and maintenance of factory motors, and the "Motorule," a cardboard, slide rule type calculator for determining horsepower required for various metal cutting operations.

Circuit Tester 47

For testing circuits in all types of electronic equipment, new unit capable of checking one circuit per second on resistances as low as .001 ohms is described in folder from Communication Measurements Laboratory, New York City

X-Ray Inspection 48

Features of small, enclosed X-ray machine for inspecting small parts and assemblies, light alloy castings, plastics, and rubber products are listed in folder distributed by North American Philips Co., New York City

MANAGEMENT & EMPLOYEES

Copper Mills 49

To aid manufacturers in placing orders for copper and brass products, Aircraft Scheduling Unit, Wright Field, has issued list of 71 mills from which these materials may be obtained.

Pensions, Bonuses 50

Chase National Bank, New York City, has prepared 92-page analysis of pension, bonus, and profit-sharing plans.

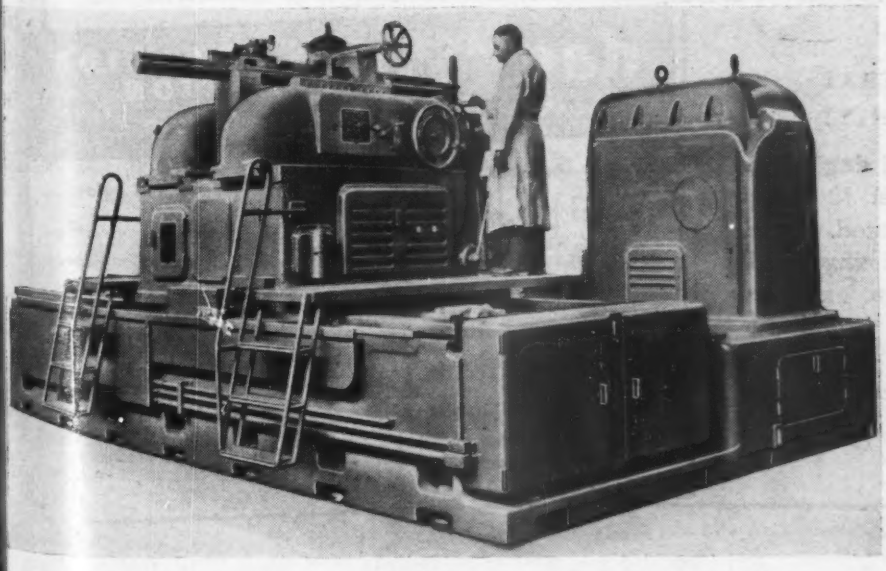
Woman Worker Safeguards 51

Review of methods for making women employees safety-conscious — including movies, lectures, posters, and attractive uniforms—is given in *Safeguarding the Woman Employee*, a report compiled by Policyholders Service Bureau, Metropolitan Life Insurance Co., New York City.

Latest Machine Tools

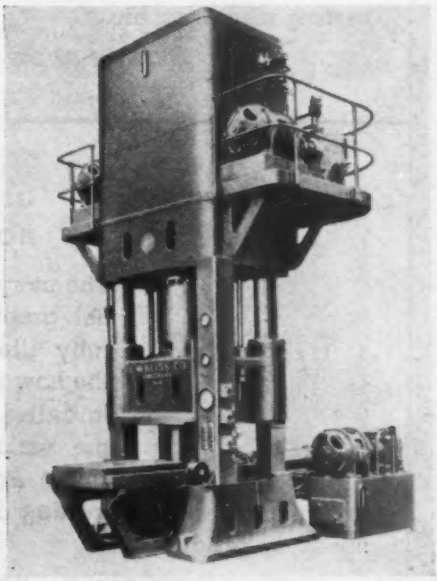
Gear Shaver 52

Announced as largest of type, machine designed for rotary crossed-axes gear shaving has maximum range from headstock spindle of 110½ in. and stands nearly 11 ft. high on a base 20x12 ft. 11 in. Its capacity is from 24 to 96 in. pitch dia. and up to 97 in. o.d. Vernier scale on cutter head and sine bar permit settings of any desired angle and accurate duplication on subsequent work. Cutting tool is driven by the work gear which can be checked without being removed from machine. Work gear (not shown in photo) is mounted on journal bearings and adjustable pedestals; its size, linear pitch, wobble, eccentricity, and pitch diameter can be determined by the chucking head. Headstock and cutter head are self-contained units, each with its own motor. Pre-selector controls amount of feed of cutter head slide across face of work gear and cutting cycle can be automatically or manually controlled. Pressure lubrication is supplied to all parts, and lubricant reservoirs have sight gages. Control stations on both sides of machine have master stops, saddle feed selectors, coolant and headstock controls, and forward and reverse regulators. Lights indicate when saddle is in feed and in which direction. At base of work headstock, says manufacturer, **National Broach and Machine Co.**, Detroit, is third control station with master stop and button to jog work spindle.—AVIATION, *Dec.*, '43

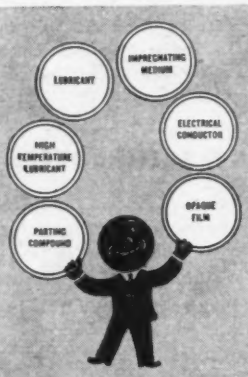


Forging Press 53

Hydraulic forging press of 1,000 ton capacity with 35-ton ejector and sliding die table has four controls for main



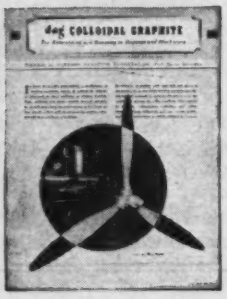
slide: 1. semi-automatic through one cycle; 2. full automatic until stop button is pressed; 3. jogging; and 4. inch-



Mr. DAG

"LET'S GET ON WITH THE WAR" *these free booklets will help . . .*

These 5 free booklets on dag colloidal graphite can help you in more ways than one. Each covers a different use or group of uses for dag products in industry. If you haven't used dag colloidal graphite or don't know all these uses meet Mr. dag today by writing for one or more of the booklets. Just clip the coupon.

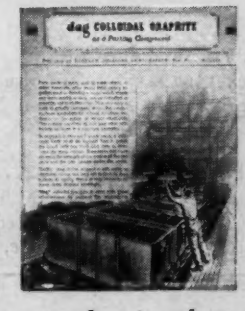


ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY

Lists 10 advantages of adding **dag** colloidal graphite to liquid lubricants for these operations and tells why with photographs, charts, and simple, non-technical text.

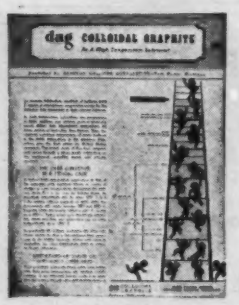
BULLETIN No. 421

PARTING COMPOUNDS



Tells how **dag** dispersions prevent objectionable freezing, rusting or sticking together of metals and other materials. Cites use on screw threads, lamp bulbs, aviation and driving equipment; also in glass, rubber and foundry industries.

BULLETIN No. 422

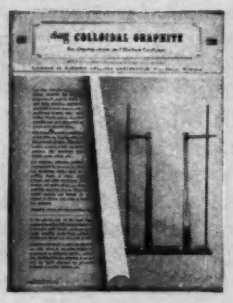


HIGH TEMPERATURE LUBRICATION

How **dag** colloidal graphite takes over when the going gets too hot for conventional liquid lubricants. Gives examples in forging, oven conveyors, kiln cars, bottle and die casting machines, etc.

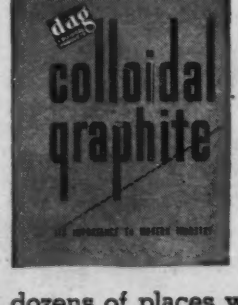
BULLETIN No. 423

"dag" COLLOIDAL GRAPHITE FOR IMPREGNATION AND SURFACE COATING



of textiles, asbestos, felt, abrasives, porous metals, paper, wood, etc. to impart lubrication properties, electrical conductivity, opacity, color, or other desirable qualities.

BULLETIN No. 431



GENERAL BOOKLET

The story of **dag** colloidal graphite. 12 pages fully illustrated. Gives the how and why of colloidalization, explains the various liquid carriers and suggests dozens of places where **dag** dispersions can speed up production.

BULLETIN No. 430

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION
Port Huron, Michigan

Please send me free copies of the bulletins checked below:

No. 421 ☐ NAME_____
No. 422 ☐ COMPANY_____
No. 423 ☐ POSITION_____
No. 430 ☐ ADDRESS_____
No. 431 ☐ CITY & STATE_____

Our Present Oil Supplier Is_____

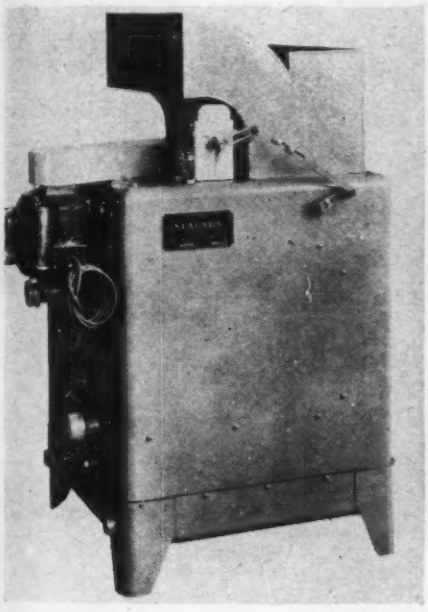
(Lubricants containing **dag** colloidal graphite are available from major oil companies.) Dept. H.

"dag" is the registered trademark of Acheson Colloids Corporation

ing. Separate pump works die slide and ejector. **E. W. Bliss Co.**, Brooklyn, N. Y., reports that 150 hp. pump gives quick advance speed of 750 in./min., pressing 37 in./min., and return 725 in./min. (units with faster speeds are available). Models are manufactured in capacity to 1,500 tons. Interlocked electrical circuits permit press, die, slide, and ejector to operate only at proper time, according to the company.—AVIATION, *Dec.*, '43.

Air Cooler 54

To produce cooler and thus dryer compressed air which will reduce water damage to pneumatic equipment, **Niagara Blower Co.**, New York City, has devised after-cooler operating on evap-



oration principle. Coils containing compressed air are cooled by a fan which blows through a water spray. Designed to produce compressed air with 50 to 75 percent less water at temperatures from 10 to 25 deg. lower than usual, machine, it is reported by manufacturer, can also be used with gases.—AVIATION, *Dec.*, '43.

● Announcements of new machine tools, shop equipment, and accessories are invited for inclusion in these columns. In writing, emphasis upon aviation industry applications of newly-marketed items is desirable, and wherever possible, glossy-print photos should be enclosed for illustration. Manufacturers should address New Products Editor, AVIATION, 330 W. 42nd St., New York City.

LIGHT
CLOSE TO THE WORK

Better lighting is a "must" in industry today—a means of attaining smoother, faster production after every other production aid has added its push.

BullDog Universal Trol-E-Duct makes possible that better lighting—brings the light right to the work—makes it easy to move or rearrange lights, or entire lighting systems, at any time and without interfering with production.

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POWER
CLOSE TO THE TOOL

Don't waste valuable production time while workers look for power outlets for portable tools. Don't risk accidents due to tripping over long cords, or shorting tangled cables.

Bring the power right to the job with BullDog Industrial Trol-E-Duct — the system that not only furnishes mobile power, but also support, for portable tools.

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MANUFACTURERS OF a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Breakers and BUStribution SYSTEMS.

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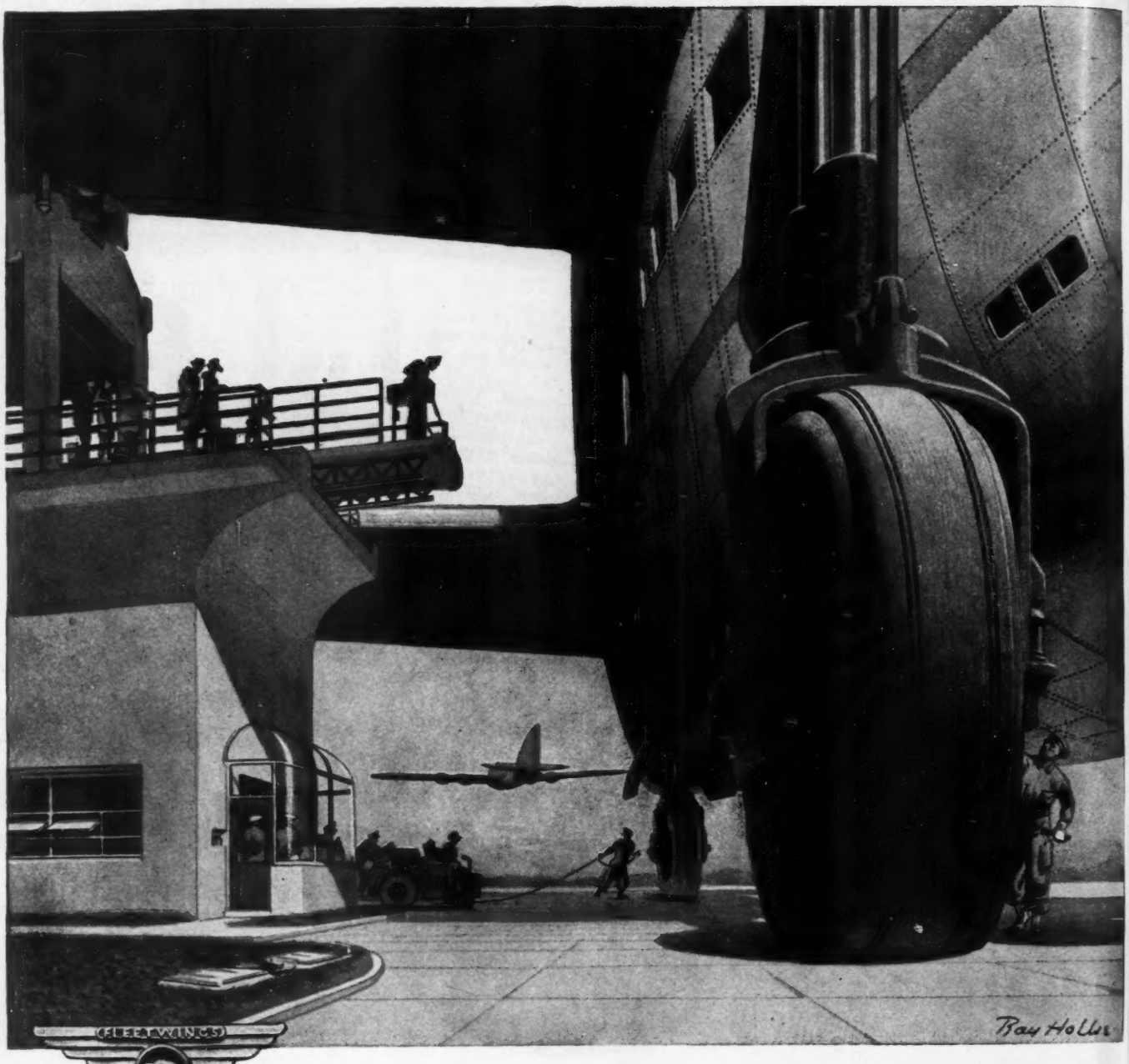
You SAVE What You SPEND for WAR BONDS

BullDog Universal Trol-E-Duct *for light,* and Industrial Trol-E-Duct *for mobile power,* are both furnished in standardized, interchangeable sections. Both are completely salvable, suitable for quick removal to a new department or to a new plant.

Ask for complete illustrated bulletins Nos. 425 and 407, describing these two time and money saving, production speeding, BullDog systems.



FLEETWINGS BUILDS A PLACE IN TOMORROW

Fleetwings, whose products are everywhere contributing to victory, is busy on a full time job. In part, the invincibility of the Flying Fortress; the sting of the Douglas Havoc and the speed of the Vought Corsair are attributable to Fleetwings' airminded production. For Fleetwings is concerned, right now, with the manufacture of tail assemblies, flaps, wings, rudders, hydraulic valves, etc. for these and other fighting aircraft. The many years of pioneering, experimentation and development have fitted Fleetwings for this work . . . provided, also, a background of leadership in the aviation industry . . . assured Fleetwings of a dominant role in the air story to be written after the war.

Plant No 1

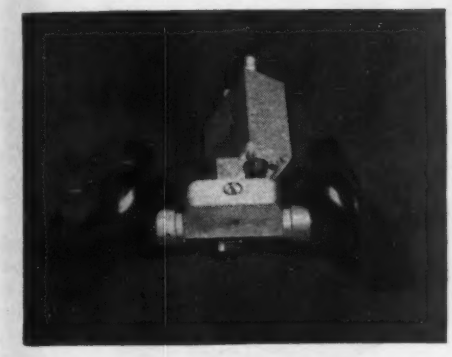
FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL • PENNSYLVANIA

FLEETWINGS

pioneers with parts and hydraulic equipment



Fleetwings B2 J2 Gun Turret Valve

PRODUCTION SHORTCUT A special tool for spinning a radius on aluminum tubing ends has been developed by an alert Fleetwinger. With it, tubing can be fed continuously through the lathe shaft, turret-cut to length and spun to a more perfect radius with a special ball-bearing spinning tool-wheel. The operation eliminates several time-consuming operations including separate chucking of pre-cut tube ends.

FLEETWINGS HYDRAULIC ACTUATING CYLINDER There are many applications for this versatile plane part. Its most common use is the operating of wing flaps. The cylinder is designed with O ring packing and a piston scraper ring. These prevent leakage and remove foreign matter from the piston surface respectively. Bosses are threaded to latest A N specifications. The cylinder will actuate at all temperature extremes and has an operating pressure of fifteen hundred psi.

THE ARROW, Fleetwings' pocket-size monthly magazine, is filled with "plane" talk for air-minded people. Rather than just a house organ for Fleetwings employes, the ARROW is fast becoming a goodwill ambassador for the workers it represents. In any one issue, you can find enough news and production hints to reward you handsomely for the time you spend in writing for your copy. Send your request on your company stationery to: THE ARROW, Fleetwings, Division of Kaiser Cargo, Inc., Bristol, Pa.

FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL • PENNSYLVANIA

Shop Equipment and Accessories

Hand Riveter 55

R. Decat, Elmhurst, L. I., N. Y., announces light-weight cast aluminum hand riveter weighing 3¾ lb. which will upset 1,200 rivets per hr. Rivets employed are reported to withstand 100 lb. pressure,

to have positive side expansion of .030 in. to fill holes drilled as much as .005 oversize, and to have passed vibration tests of 100,000,000 cycles in temperature range of −20 deg. C. to +80 deg. C. Rivets are contained in mandrel in barrel. Turning crank, connected through cam and gear, exerts 1,000 lb. pressure.—AVIATION, *Dec.*, '43.

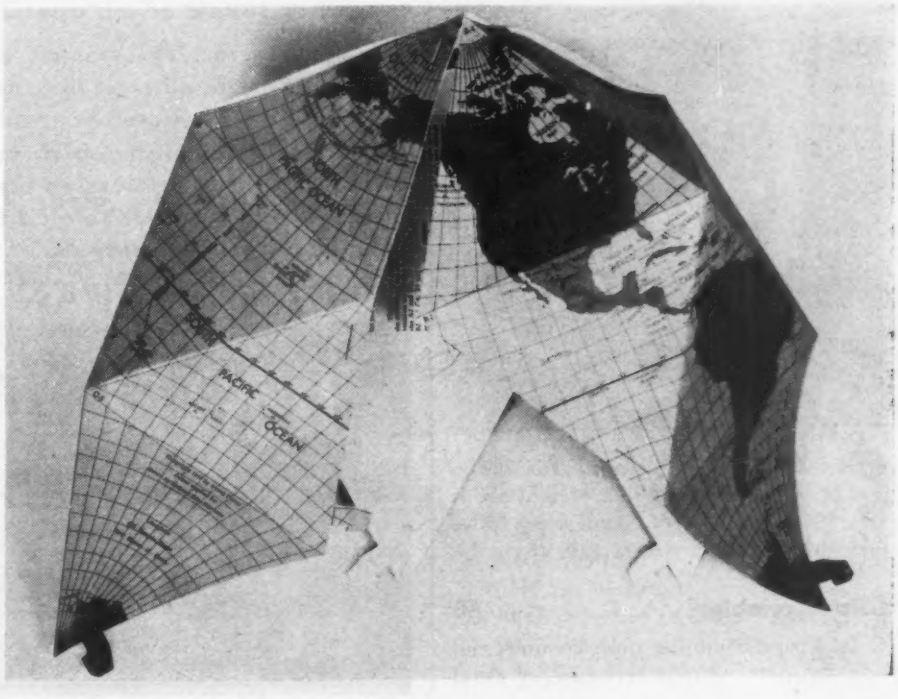
Map-Globe 56

World map which can be folded into globe with minimum geographical distortion has been devised by Prof. Irving Fisher of Yale and is being sold by **Likaglobe**, New Haven, Conn. It is available for flat use and for folding into 20-sided globe. Large size is available in two-colors with markings of principal places.—AVIATION, *Dec.*, '43.

Service Stand 57

Aircraft service stand, adjustable from 13 to 20 ft., has capacity of 1,500 lb., double acting hand pump, and

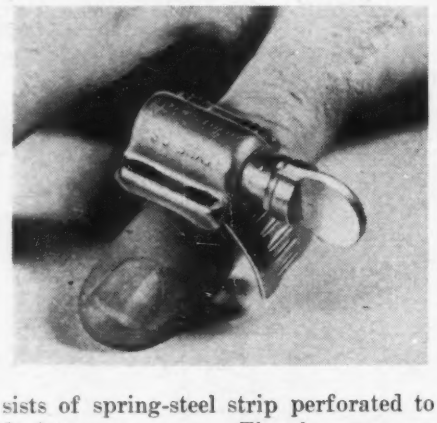
tubular steel base which can be knocked down for shipping. Stand rolls on four casters of 8 in. dia. and is leveled and



steadied when in position by four screws and floor pads. It occupies floor space 10x14 ft., says maker, **Pacific Engineering Corp.**, Los Angeles, and weighs about 1,275 lb.—AVIATION, *Dec.*, '43.

Hose Clamps 58

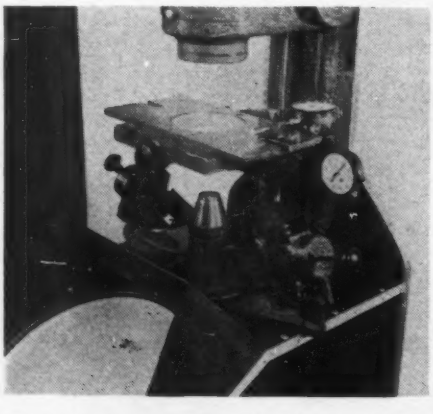
Two new model hose clamps added to line of **Aircraft Standard Parts Co.**, Rockford, Ill., increase to 16 company's line for aircraft hose sizes from ¼ in. to 4 in. i.d. Take-up mechanism con-



sists of spring-steel strip perforated to fit into worm gear. Thumb screw can tighten larger sizes as much as 1 in. dia. Worm gear arrangement eliminates need for lock wire and is reported to withstand considerable vibration.—AVIATION, *Dec.*, '43.

Optical Comparator 59

Larger coordinate stage for greater mechanical capacity and larger faces on dial indicators are features of model P2-14 optical comparator being marketed by **Portman Machine Tool Co.**, New Rochelle, N. Y. Magnification lenses are available in strengths of 10X, 31¼X, 50X, 62½X, and 100X. Blower cools lamp assembly which includes larger con-



denser lens and adjustment for beam. Image screen is 14½ in. dia., weight about 400 lb., height 60 in., and floor space occupied 24x30 in.—AVIATION, *Dec.*, '43.

Clip Assembler..... 60

Tool for assembling pipe, conduit, and tube support clips is reported by **Adel**

MODEL UHX—10,000 BTU

HUNTER HEATERS MIGHT SOLVE YOUR PROBLEM

MODEL UH2—25,000 BTU

MODEL UH3—40,000 BTU

Burn any type of gasoline—from truck fuel to 100 octane!

Uses for Hunter Universal Gasoline Heaters are too widespread and varied to list completely, and are multiplied daily by the imagination and ingenuity of men who build, buy or command equipment for the service or supply of our armed forces, or essential civilian activities.

We build a variety of small, powerful units, each with a range of applications to which it is especially suited. YOUR heating problem may be one of these, or it may be one on which Hunter heating engineers can assist you in applying the extremely flexible basic units of Hunter Heaters to do exactly the job you need done. In either event, we shall be glad to furnish further information specific to your particular interests.

BULLETIN HB-3 *ON REQUEST*

HUNTER AND COMPANY

Aircraft Equipment

1550 E. 17th St.

CLEVELAND • OHIO

HUNTER HEATERS MADE FOR RAPID WATER HEATING

Automatic Gasoline Burning Models Designed for Mobile Service Units

CLEVELAND, OHIO—A gasoline burning water heater that will supply water at high temperature, and that is capable of automatically maintaining a continuous supply, has been perfected by Hunter and Company of this city, makers of Hunter Universal Gasoline space heaters.

Two models are at present available. One is a portable unit with a ten-gallon pressure tank that is suitable for connection to any permanent or emergency water supply. It is completely automatic. The other is a five-gallon unit with a gravity type tank, designed to heat small quantities of water in a hurry. This heater is meant to be permanently installed in any kind of mobile service unit where there is frequent need for hot water. It fastens to a wall, and may be filled through an opening in the top, or connected to a hand pump or to a pressure water system.

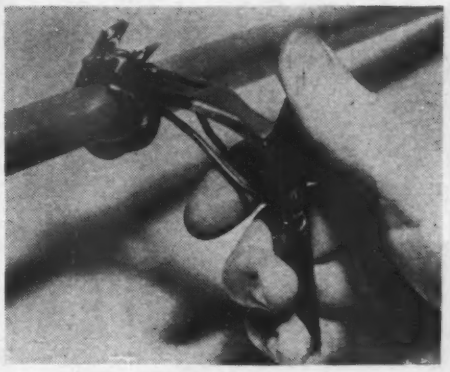
Hunter Automatic Water Heater

In both models, the heating element is a Hunter Universal Gasoline Burner, with "Sealed in Steel" flame, adapted as an immersion unit. The steel tube burner, with its terrific heating capacity, is immersed deep in the liquid to be heated. Unusual results are obtained in speed of heating and flexibility of automatic control. The same principle has been used by Hunter in special applications in storage or shipping tanks to protect oil or other fluids against cold.

These advantages, combined with the fact that the Hunter burner operates on any kind of gasoline, from truck fuel to highest octane, give Hunter Water Heaters an almost unlimited range of usefulness in mobile photographic, laboratory or hospital units, in field service units of all kinds . . . anywhere it is desirable to have an extremely simple and effective means to supply hot water.

More complete details about Hunter Water Heaters and their application may be obtained from Hunter and Company, 1550 E. 17th St., Cleveland, Ohio.

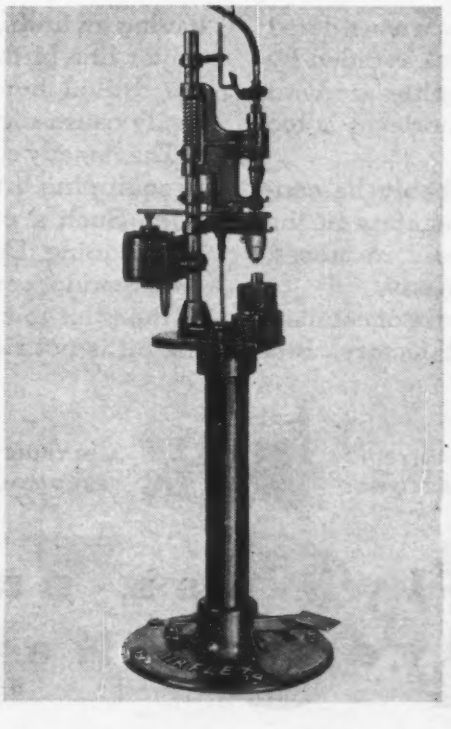
(Advertisement)



Precision Products Corp., Burbank, Calif. Time saving, states company, is feature, with fatigue and possibility of finger injuries said to be reduced. Handle of tool is in two parts, joined at a fulcrum. Under handle is a formed wire which is placed over clip, pincer fashion, when handle is jack-knifed. A pull straightens out handle and draws sides of clip together. This assembler may be used on clips from any direction —front, back, above, or below.—AVIATION, *Dec.*, '43.

Riveter 61

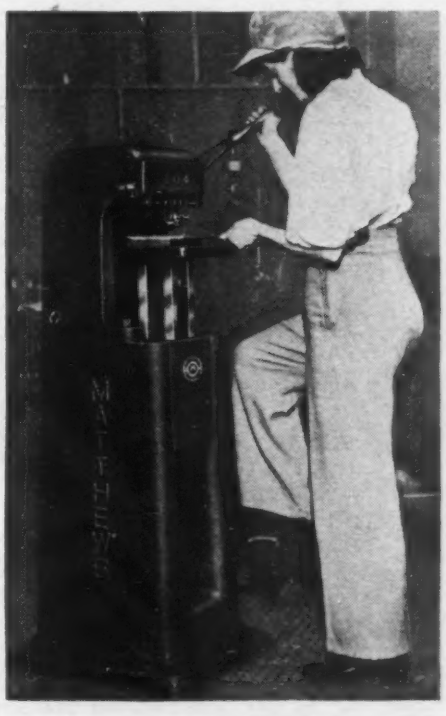
Advance pressure pad, consisting of spring and pilot which precede peening tool to hold assembly rigid against rivet set, is feature of late model riveters manufactured by **Airflex Equipment Co.**, Detroit. Machine can make round, oval, and flat head rivets, peens, shafts, pins, and studs, and furl or swage shoulder bushings and light tubes to sheet metal or plastics. Air-operated peening tool delivers strokes of $\frac{1}{4}$ in. max. Air, supplying force and frequency to blows, is controlled by petcock. Rotation is by $\frac{1}{8}$ hp. motor with push button switch. Frame travel is approximately 2 in.,



frame adjustment on post 4 in. Models are manufactured with capacities of 5/32, $\frac{1}{4}$, and $\frac{5}{8}$ in.—AVIATION, *Dec.*, '43.

Marker 62

Codes and other identification marks can be stamped with this machine on various shapes and sizes up to 6 in. dia. or thickness. Solid roller dies are used on flat parts and can be interchanged with flat dies for round parts. Fixture on machine table holds part which is then raised by depressing foot pedal; pulling down handle moves die across part. Specifications, as given by



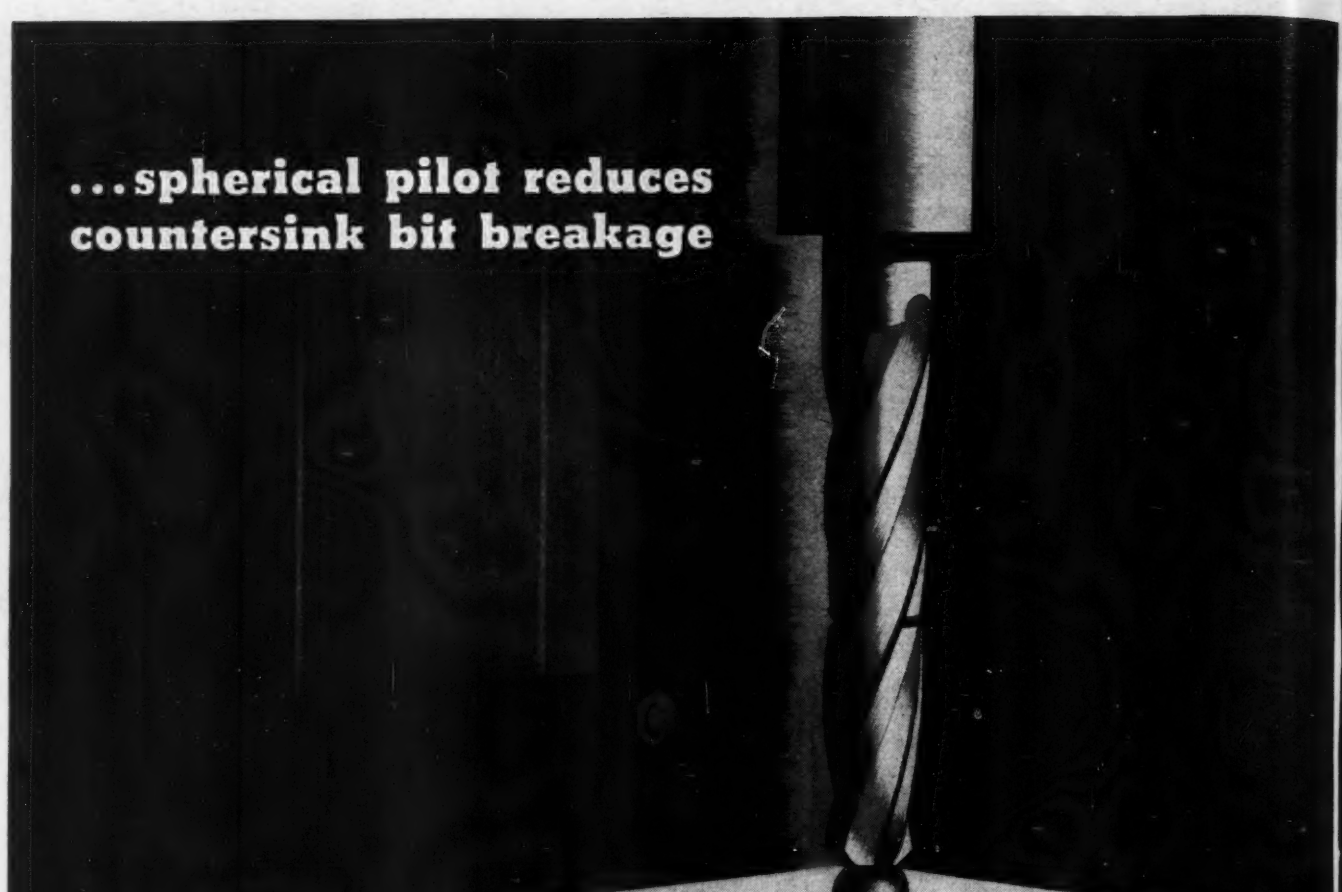
maker, **Jas. H. Matthews & Co.**, Pittsburgh: Die stroke, round parts $3\frac{1}{2}$ in., flat parts $4\frac{1}{2}$ in.; table rise 7 in.; table size 9x8 in.; throat from center of die to front of uprights $3\frac{1}{2}$ in.; opening between uprights 8 in.; height of table from floor 43 in. max., 36 in. min.; floor space occupied 19x20 in.; overall height 52 in.; weight 500 lb.—AVIATION, *Dec.*, '43.

Check Valve 63

Hydraulic check valve introduced by **Electrol, Inc.**, Kingston, N. Y., is made in three screw machine-finished parts. None of them contain any hardened steel, thus conserving materials, reducing cost, and eliminating grinding and honing.—AVIATION, *Dec.*, '43.

Seam Welder 64

Assemblies mounted in fixtures and parts too big for machines can be seam-welded, it is reported by **Progressive Welder Co.**, Detroit, with air-operated portable machine capable of holding



Information supplied by an Industrial Publication

Tool breakage—even in what was once considered "normal amounts" is something to be avoided by any means today. Replacement supplies are hard to get, and the possibility of tool shortages is too serious to permit temporizing.

In many cases breakage can probably be considerably reduced by educating operators in the proper use of cutting tools. In some instances, redesign of the tool may be the remedy.

Redesign was the solution in the case of countersink drill bits used in an aircraft factory. Bits having cylindrical pilots often broke when the center line of the bit was at an angle with that of the drilled hole. Run out in the spindle could easily cause such deflection.

The remedy suggested by an employee consisted of equipping bits with a spherical, or ball shaped, pilot. Such a pilot has the effect of making bits self aligning. Deflection through a relatively wide angle cannot concentrate enough stress at the neck of the pilot to cause breakage, because the end of the bit is not rigidly held.

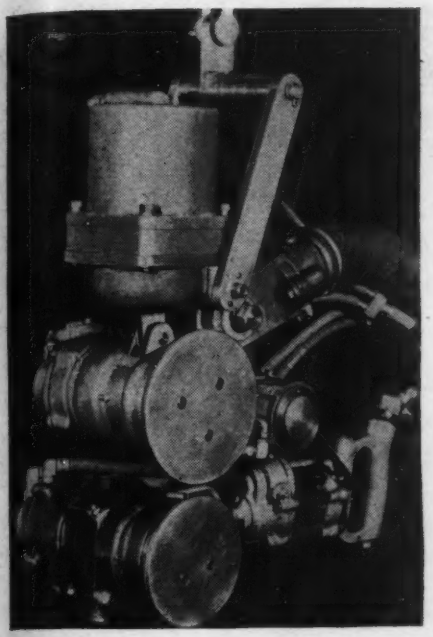
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

MOLY

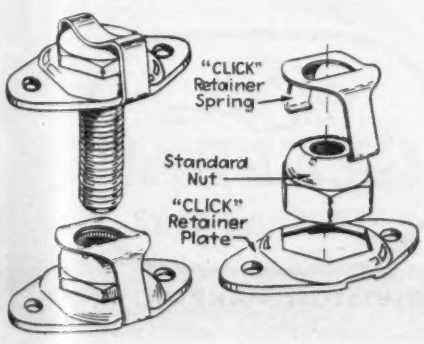
Climax Molybdenum Company
500 Fifth Avenue • New York City



material, including stainless steels, to 20 gage 2 in. thick. Universal suspension permits gun to be moved in practically any horizontal or vertical direction. At constant speed, air motor, regulated by governor, is rated at 2 hp. and consumes 42 cu. ft. under load. Using standard rolls or wheels, production speed is 48 to 52 in. per min. When air pressure, a maximum of 1,400 psi. obtained from 4½ in. dia. cylinder on 90 lb. line, reaches pre-set value lower wheel begins to move and timer starts welding process. Relaxing button control causes solenoid to release air in cylinder, and welding is stopped. Water cooling, 5 gpm., is supplied to transformer, cable, jumper, bushings, and interior of wheels. Transformer is rated at 100 kva. on 440 v., 60 cycles. Heat is regulated by six-stage dial, and speeds higher and lower than standard 48 to 52 in. rate are obtainable through spur gears and double worm drive. Throat depth of gun is 3 in.—AVIATION, *Dec.*, '43.

Retainer 65

Nut and bolt retainer is announced by **Kaynar Mfg. Co.**, Los Angeles, under trade name Click. Of simple design, retainer plate and spring, (cadmium plated and tempered spring steel) are installed by spot welding or riveting at any stage of manufacture. Attaching dimensions are held to .002 in., eliminating line drilling of assemblies and allowing prefabrication of holes. For use with blind nuts, fasteners can be quickly adapted without effecting structural design. This retainer is interchangeable with present types of anchor fittings.—AVIATION, *Dec.*, '43.



Beam Compass 66

Micrometer adjustment at pivot point of beam compass permits measurement to be set to approximately .001 in., according to **Mark Specialty Co.**, Rochester, N. Y. Pivot pin, a phonograph needle, is retained at specified projection by nut. Standard led pencil chuck will also hold steel point for marking metal. Bar can be supplied in lengths of 18-, 24-, and 36-in. or longer.—AVIATION, *Dec.*, '43.

You can't have spring quality and service without it!

PROPER BALANCE, timing and coordination between skilled employees, modern equipment and methods, and rigid production control are responsible for Accurate quality and service—to give you the springs and wireforms you want... *when you want them.*

From the specification stage through the precision manufacturing operations and the steps of testing and inspection, the Accurate organization works in smooth, production-building balance. Accurate engineers, too, are specially trained to work hand-in-hand with your own engineers to produce the precise springs or wireforms for the job, thus eliminating waste motion, saving time, trouble and headaches.

We know you will like the friendly cooperation and product quality which you will find at Accurate. When you have spring and wireform problems, bring them to us.

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SPRINGS ★ WIRE FORMS ★ STAMPINGS

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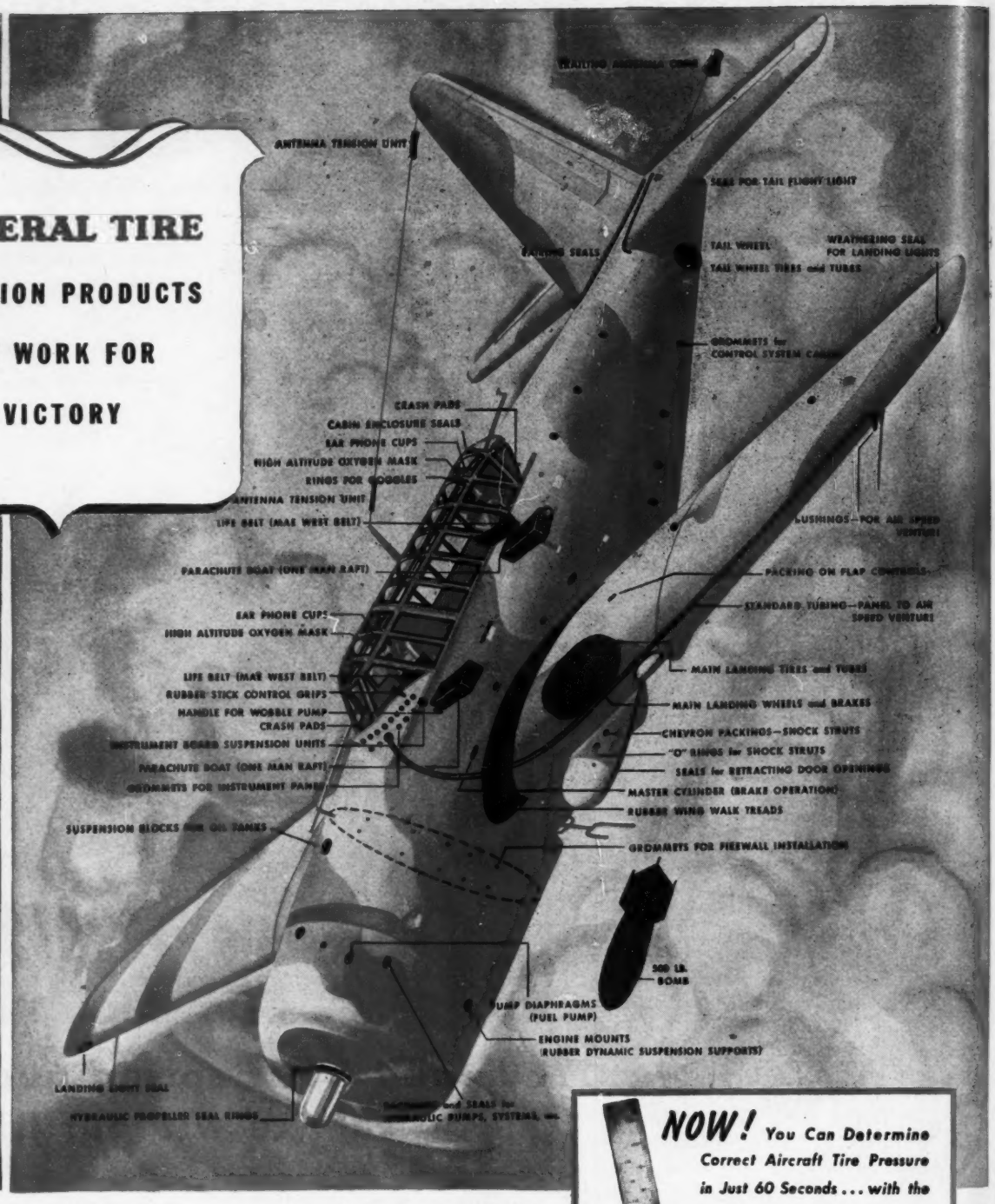
GENERAL TIRE

AVIATION PRODUCTS AT WORK FOR VICTORY


ANTENNA TENSION UNIT
SEAL FOR TAIL FLIGHT LIGHT
TAIL WHEEL
WEATHERING SEAL FOR LANDING LIGHTS
TAIL WHEEL TIRES and TUBES
GROMMETS for CONTROL SYSTEM CABLES
CRASH PADS
CABIN ENCLOSURE SEALS
EAR PHONE CUPS
HIGH ALTITUDE OXYGEN MASK
RINGS FOR GOGGLES
ANTENNA TENSION UNIT
LIFE BELT (MAE WEST BELT)
BUSHINGS—FOR AIR SPEED VENTURI
PARACHUTE BOAT (ONE MAN RAFT)
PACKING ON FLAP CONTROLS
STANDARD TUBING—PANEL TO AIR SPEED VENTURI
EAR PHONE CUPS
HIGH ALTITUDE OXYGEN MASK
MAIN LANDING TIRES and TUBES
LIFE BELT (MAE WEST BELT)
RUBBER STICK CONTROL GRIPS
HANDLE FOR WOBBLE PUMP
CRASH PADS
MAIN LANDING WHEELS and BRAKES
CHEVRON PACKINGS—SHOCK STRUTS
"O" RINGS for SHOCK STRUTS
SEALS for RETRACTING DOOR OPENINGS
MASTER CYLINDER (BRAKE OPERATION)
RUBBER WING WALK TREADS
GROMMETS FOR FIREWALL INSTALLATION
500 LB. BOMB
PUMP DIAPHRAGMS (FUEL PUMP)
ENGINE MOUNTS RUBBER DYNAMIC SUSPENSION SUPPORTS)
LANDING LIGHT SEAL

★ Not until the war is over . . . not until it can all be told . . . will the tremendous part being played by miscellaneous rubber aircraft parts be fully known. But they're there! The General Tire & Rubber Company alone makes *hundreds* of parts . . . gaskets, grommets, brake boots, pump diaphragms . . . *anything molded or extruded, synthetic or natural!*

And every item produced is a specialty. There are no "stock items." Your inquiry gets immediate attention . . . is the signal for a corps of trained engineers to swing into action . . . to produce for you the most efficient, economical and effective performance of that part! *So, special "problem" or otherwise . . . write, wire or call General today!*

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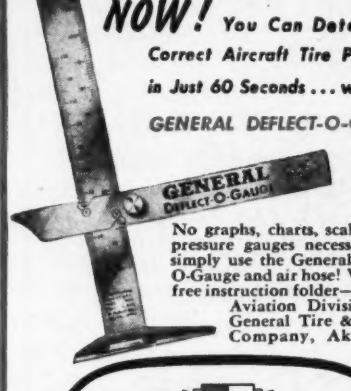
NOW! ***You Can Determine Correct Aircraft Tire Pressure in Just 60 Seconds . . . with the GENERAL DEFLECT-O-GAUGE***



No graphs, charts, scales or air pressure gauges necessary . . . simply use the General Deflect-O-Gauge and air hose! Write for free instruction folder—Address: Aviation Division, The General Tire & Rubber Company, Akron, O.

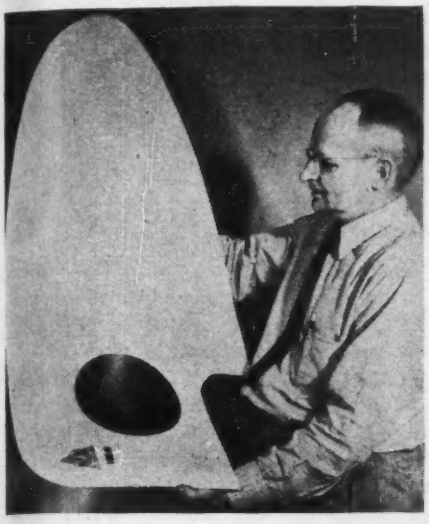
The **GENERAL** AIRPLANE TIRE

★

THE GENERAL TIRE & RUBBER CO. • AVIATION DIVISION • AKRON, OHIO

Plastic Tank Holder..... 67

U. S. Rubber Co., New York City, announces that a plastic-board it has developed is being used to support self-



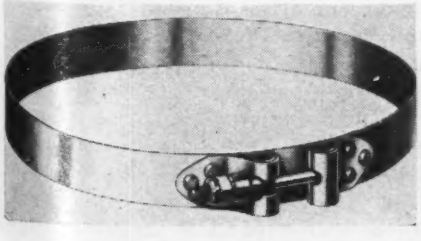
sealing gas tanks and in construction of de-icer fluid tanks. Material is stated to break clean when hit by bullets, weighs half as much as aluminum, has weight strength ratio comparable to other metal alloys, is a non-conductor of electricity, and can be used over wide temperature range. Board, as indicated in photo, can be cut in various shapes.—AVIATION, *Dec.*, '43.

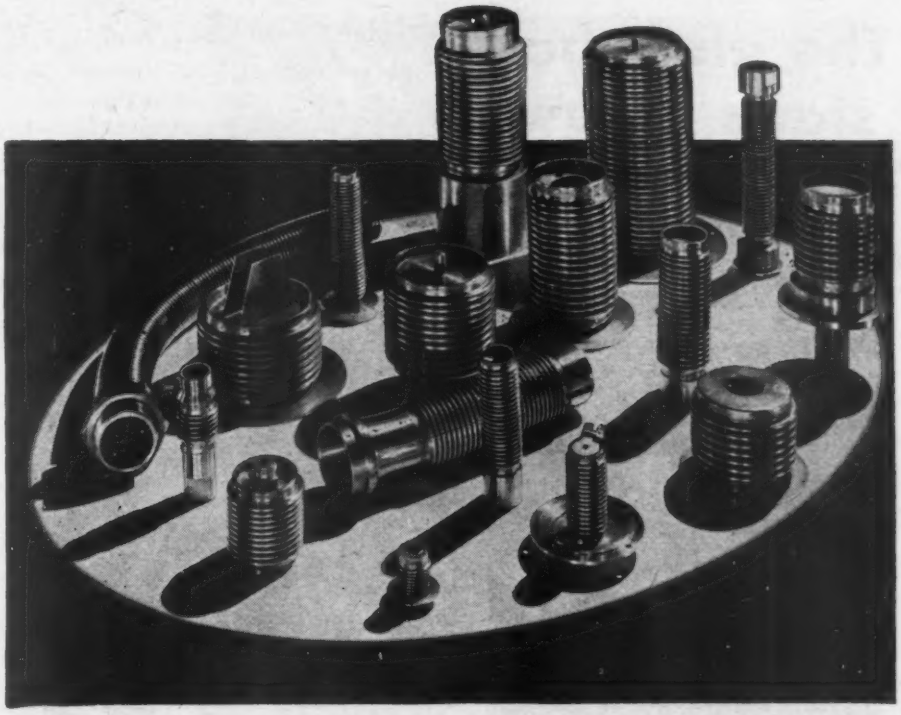
Plastic Cement..... 68

Offered by **Arpin Products Co.**, Orange, N. J., is No. 1 cement for use with Plexiglas and Lucite. Initial bonding strength is stated to make product specifically suited for repair work.—AVIATION, *Dec.*, '43.

Clamps..... 69

Aluminum alloy clamp, with ends wrapped over cross-bar anchors, combines maximum strength with extremely light weight. Announced by **Marman Products Co.**, Inglewood, Calif., new clamp is said to save 50 percent in weight and to distribute all loads evenly. The 5½ in. size (illustrated) has yield strength of 600 lb. and weighs 1 oz. Models were designed for aircraft use in ventilation, carburetor intake, supercharger, intercooler, and similar installations. They are available from 2 in. i.d. up and in wide range of special shapes.—AVIATION, *Dec.*, '43.





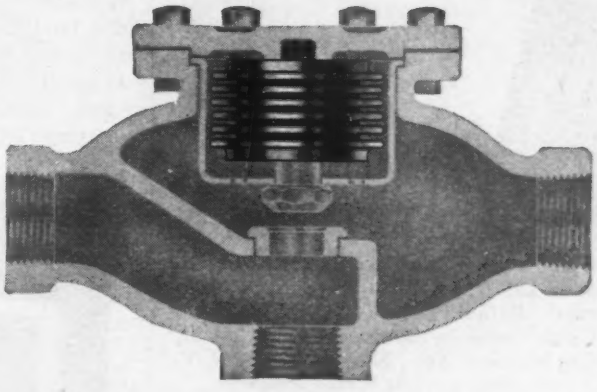
CMH

Stainless Steel Bellows

Wherever stainless steel's corrosion resistant qualities and temperature values are required in bellows service, CMH unimetal **circular seam welded** assemblies are filling that need.

No Solder or Flux Required

Long lengths of CMH Bellows are standard production; strength is further enhanced with **multiple ply** assemblies when needed.



Ask for engineering recommendations on specific applications.

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General Offices: MAYWOOD, ILLINOIS

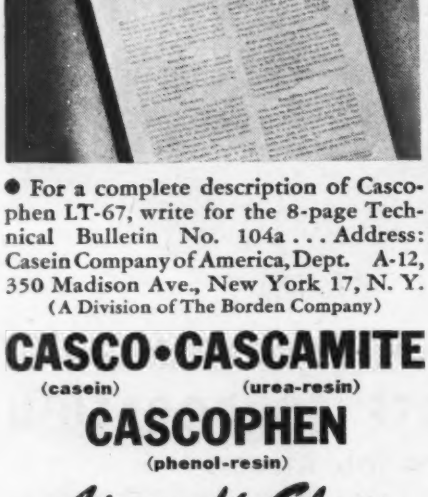
Factories: Maywood and Elgin, Illinois

The glue that starts a new "Age of Wood"

THIS is the glue that makes possible assembly and joint gluing just as durable as the finest hot-press plywood bonds.

Because Cascophen LT-67 is an *alkaline,* warm-setting phenol-resin glue, it develops and maintains the full strength of the wood under all conditions of exposure, including prolonged high temperatures.

Cascophen LT-67 is available today—for wood war-products. Available after the war for better wood products of every type.

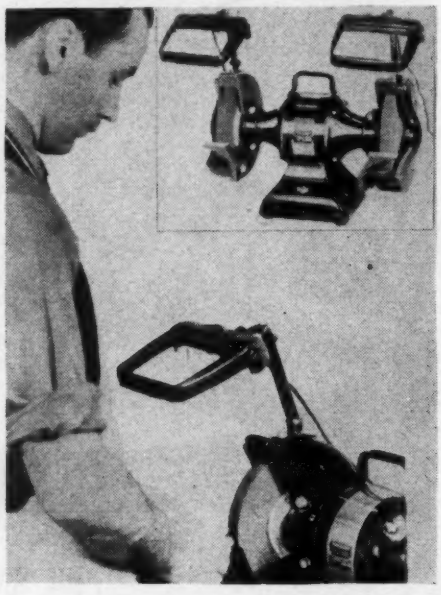


● For a complete description of Cascophen LT-67, write for the 8-page Technical Bulletin No. 104a . . . Address: Casein Company of America, Dept. A-12, 350 Madison Ave., New York 17, N. Y.
(A Division of The Borden Company)

CASCO•CASCAMITE
(casein) (urea-resin)
CASCOPHEN
(phenol-resin)
Aircraft Glues
to meet all aircraft specifications

Grinder Shield 70

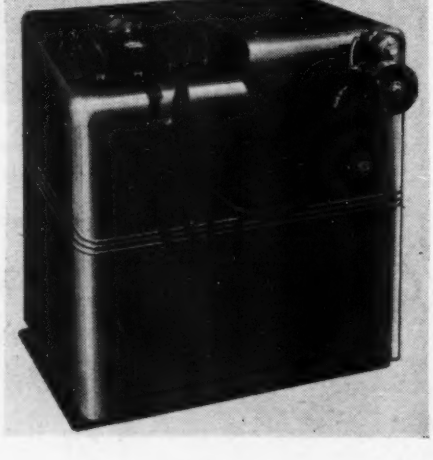
Boyer-Campbell Co., Detroit, announces new grinder shield with shatterproof glass and frame made of high impact resisting plastic. Bayonet-type



light is set flush with frame and controlled by push button switch.—AVIATION, *Dec.*, '43.

Starter Tester 71

New starter test stand is announced by **Airplane Mfg. Co. Supply Corp.**, North Hollywood, Calif., for right or left direction, S.A.E. 5, 6, and 7 in. aircraft starters. Known as the Amsco, it provides a single mounting plate to accommodate all listed types and sizes. Tests are obtained by torque action of starter, transmitted through a two-way arm to a double-action hydraulic cylinder which, in turn, registers in foot pounds on a maximum limit hand pressure gage. Standard gage furnished with tester allows readings up to 2,800 ft.-lb. on most starters. An ammeter, mounted on instrument panel, checks starter motor "draw" during flywheel energizing. All necessary switches, including selector for



12 or 24 v. operation, are part of panel equipment. Functionally designed cabinet is 38x36x28 in. Wiring and moving parts are fully enclosed; ball-bearing casters permit easy movement. Instrument panel is slanted for convenient reading and accessibility of switches. Either battery or rectifier models are available, battery model containing a charger and "tell-tale" signal light.—AVIATION, *Dec.*, '43.

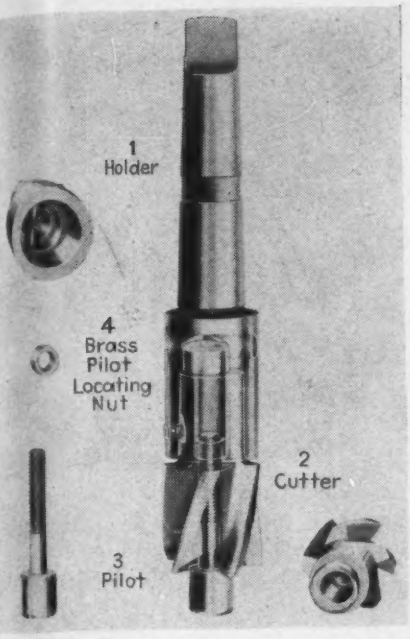
Measuring Gage 72

Sheffield Corp., Dayton, Ohio, provides on new instrument for internal and external measuring an electric gage, developed in collaboration with Westinghouse, with range of .0012 in. and graduated in 50 millionths (.000050). Magnification of gage head is 2,500 to 1. Push buttons raise gaging arms electrically. They are suitable for measuring diameters or internal dimensions from ¾ to 12 in. and explore holes 3 in. deep. As an external comparator, machine can check rounds, straights, and

tapers with maximum dimension of 12 in. It was designed for measuring working ring, snap, and length gages.—AVIATION, *Dec.*, '43.

Counterborer 73

Production of a range of sizes of counterbore drives is underway by **Moreland Tool Co.**, Detroit. Specific design, in which driving member fits into spherical off-center hole in holder, aims to equalize torque between driving member and holder. Possibility of shearing is also reduced. Due to length of pilot screw which holds cutter, cutter itself can be sharpened more than two-thirds



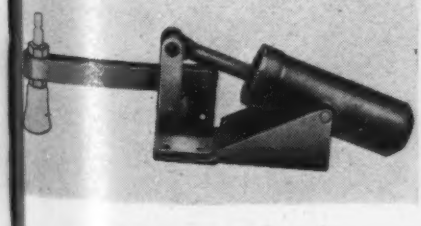
way before replacement. Four sizes of olders are made with straight or tapered hanks for cutters up to 3 in. dia.—AVIATION, *Dec.*, '43.

Rev Counter..... 74

Direct 1:1 drive with precision steel ears and Veeder-Root counter are used n light (8 oz.) device for recording umber of revolutions turned on shafts hen making rotary coil turns, recording ertical and horizontal stabilizer adjustents, or other operations in which hafts must be revolved a predetermined umber of times. Standard model recrds up to ten turns in increments as low s 1/10. Others are available with anges of 100 and 1,000 in right and eft directions from **Barker & Williamon**, Upper Darby, Pa.—AVIATION, *Dec.*, '43.

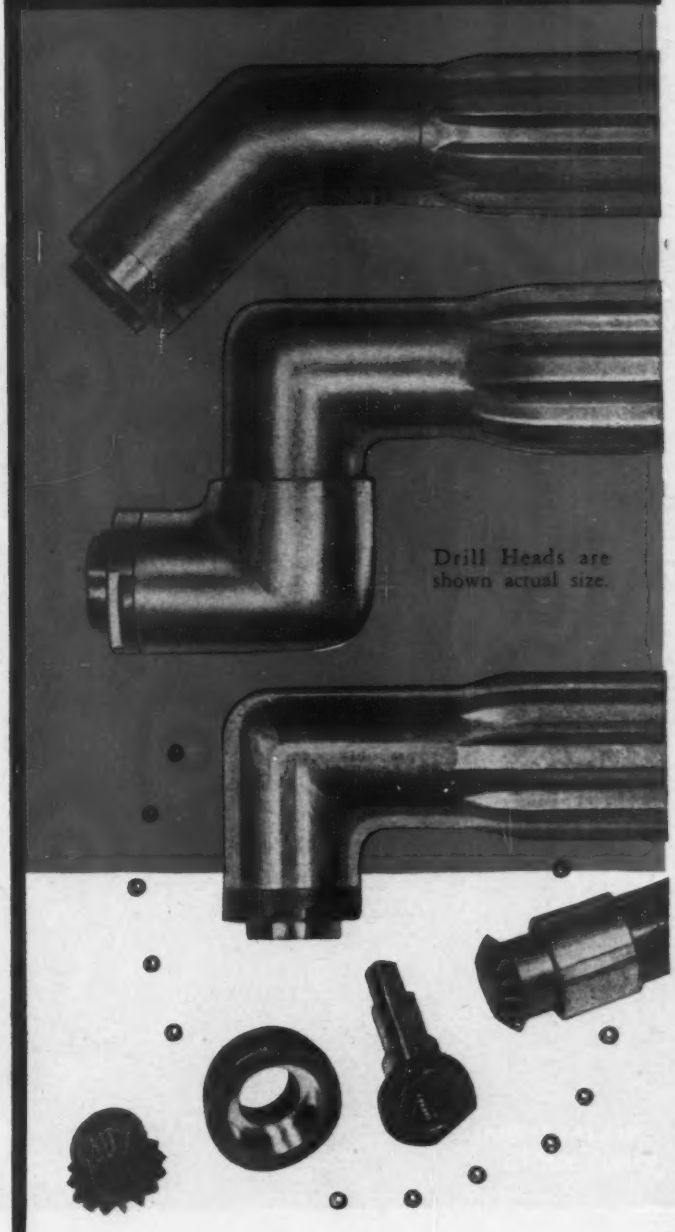
Toggle Activator..... 75

New device is designed to relieve workrs of job of walking around large parts r assemblies to set toggle clamps. Airperated unit loosens or tightens clamps multaneously from one control point. ir at 40 to 150 psi. fed to a cylinder oves arm which locks or loosens toggle. hen locked, this acutuator maintains 25 psi. at end of clamping bar. Bar wings 90 deg. Device, which weighs lb., is being manufactured by **Airop**, nc., Dearborn, Mich.—AVIATION, *Dec.*, 3.



3 NEW "ANGLES"

DIE CAST BODY
BALL BEARING SPINDLE



New nibbed die cast body

Operates in any position throughout 360°

All three have new ball bearing mounted spindle

All parts are precision made

These new Zephyr angle head drills provide the last word in design . . . give better service over longer periods. Improved features include: Combination radial-thrust ball bearing mounted spindle; oilite bearings for drive shaft and spindle pilot; oversize drive shaft; die cast housing; all parts heat treated and completely interchangeable. Zephyr Tools are used in major aircraft plants in all parts of the country. Order a quantity now for actual test in your plant.

Write, on your letterhead, for our catalog.

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ZEPHYR

High Quality Precision Tools

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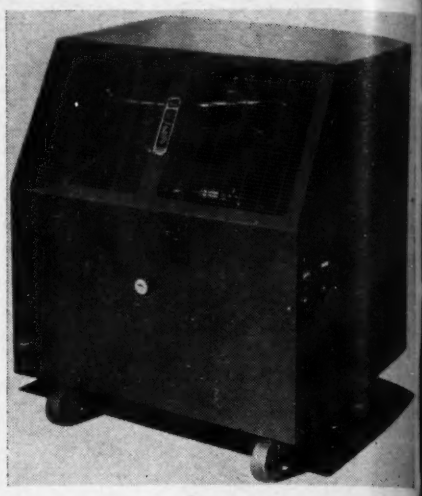
Write for address of nearest branch office or dealer representative.

Tool Alloy..... 76

Designed to fill gap between high-speed steels and tungsten carbide, tool alloy for machine work is composed of cast tungsten-chromium-cobalt alloy. With exception of manganese steel and chilled iron, it is designed to machine all materials, being particularly suitable for chromium and nickel alloys and stainless steel. Production rates, with about same depth cut as high-speed steels, is reported one-quarter to one-half faster. It is called Speedaloy by **Tungsten Alloy Mfg. Co.**, Newark, N. J.—AVIATION, *Dec.*, '43.

Fluid Refrigerator..... 77

Requiring no water connections and ready to plug into power supply, new self-contained, portable cooler has been designed for use with metal cutting coolants, hydraulic and quenching oils, spot welders, and for settling and screening out chips. Dimensions are 28½x33x44 in., and 1 hp. compressor is rated at 11,800 Btu. Optional centrifugal or gear pump, operated by ½ hp. motor, are rated at 3,000 gph. at 7 lb. pressure and 180 gph. at 50 lb. pressure, respectively. Coolant tank has 25-gal. capacity and settling and filtering screens. Baffle plates are provided for removing chips collected. Maker, **Gray-Mills Co.**, Chicago, calls this machine Model 400.—AVIATION, *Dec.*, '43.

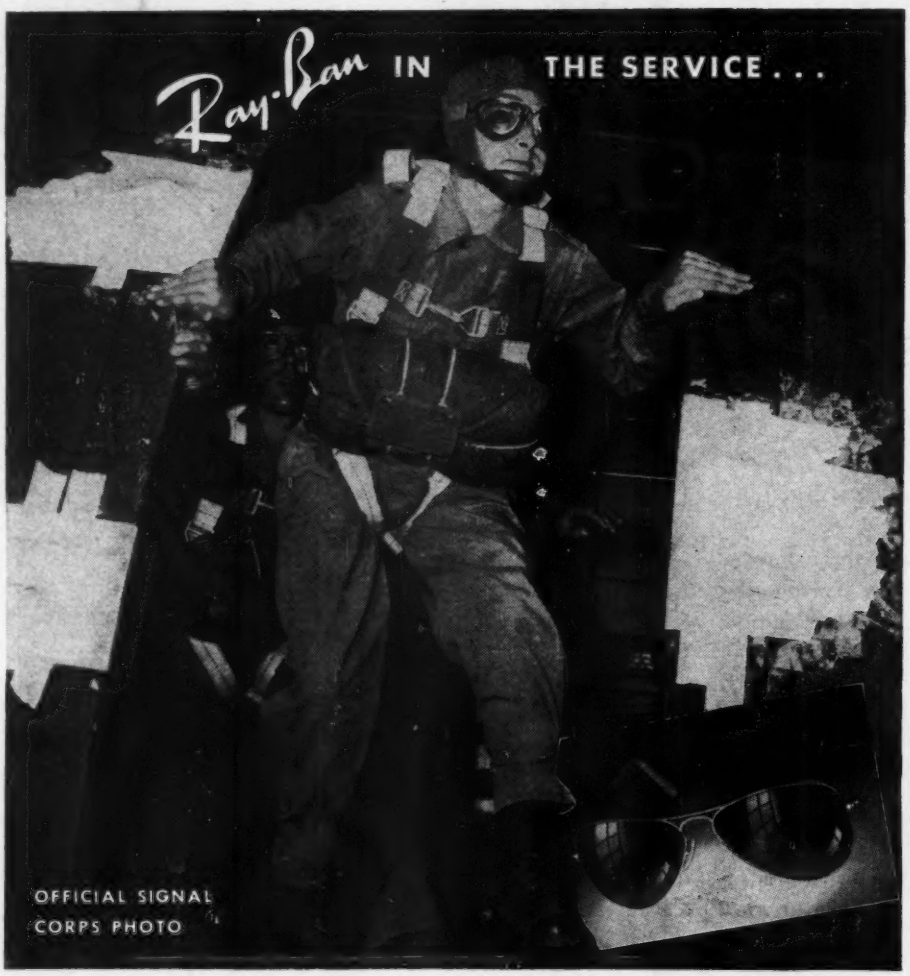


Duplicator..... 78

Dupligraph is name given new machine for duplicating contours of irregular surfaces, such as propellers, and for obtaining concave readings on forming dies without need for forming templates. Shape of object is obtained by means of stylus and pentagraph which can mark either transparent paper or metal. It is made by **Inter-Lakes Engineering Co.**, Detroit.—AVIATION, *Dec.* '43.

Carbide Blocks..... 79

Practically non-magnetic, cemented carbide gage blocks, estimated to last many times longer than steel, are furnished in two grades of accuracy, .00000 and .000008 in., by **Lincoln Park Tool & Gage Co.**, Lincoln Park, Mich. Set of 14 blocks includes these sizes .050 in., .100, .05005, .0501, .0502, .0503, .0504, .0505, .0506, .0507, .0508, .0509 They complement standard build-up 81-piece sets.—AVIATION, *Dec.*, '43.



20/20 VISION . . . HE STILL NEEDS Ray-Bans

Poised for his leap into space, this paratrooper knows the full comfort Ray-Ban sun glasses give keen eyes.

With eyes protected against the blinding dazzle of the desert sun, he quickly sees a safe landing spot and works his parachute toward it. Hours spent on blistering desert sands do not burn his eyes—behind their cool, comfortable Ray-Ban lenses.

That's why Ray-Ban sun glasses are sold out to the Army and Navy today—why Ray-Ban lenses are available to civilians *only on prescription.*

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OPTICAL CO. ROCHESTER, N. Y.
ESTABLISHED 1853

AN AMERICAN SCIENTIFIC INSTITUTION PRODUCING OPTICAL GLASS AND INSTRUMENTS FOR MILITARY USE, EDUCATION, RESEARCH, INDUSTRY AND EYESIGHT CORRECTION

(Photo Courtesy Yerkes Observatory)

Same Shape in 1943000

THE AVIATION INDUSTRY
OK's* SYNTHANE *for:

LIGHT WEIGHT with Strength
LIGHT WEIGHT with Corrosion Resistance
LIGHT WEIGHT with High Dielectric Strength
LIGHT WEIGHT with Ease of Machining

ANDROMEDA NEBULA will look the same eons from now. No man-made material, Synthane or any other, approaches such permanence. With respect to temperature, however, Synthane does change very little in shape. High temperatures do not soften it, low temperatures do not make it brittle. Over a range from −67° F to +158° F, changes in temperature do produce changes in other properties of Synthane, such as mechanical and electrical characteristics, water absorption, corrosion resistance, and hardness. But since these changes are moderate Synthane is amply satisfactory for most aircraft applications. For information on the effects of temperature changes upon Synthane, turn to the back of this sheet.

SYNTHANE CORPORATION, OAKS, PENNSYLVANIA

Materials to remember, specify and use for Aircraft Parts

SHEETS • RODS • TUBES • FABRICATED PARTS

SYNTHANE

MOLDED-LAMINATED • MOLDED-MACERATED

SYNTHANE *vs.* TEMPERATURE CHANGES

Changes in Shape

Among the many properties of laminated plastics, one of those most desired by aircraft engineers—aside from light weight—is resistance to change in shape with a change in temperature over a range of − 67° to + 158° F.

Synthane has a low coefficient of thermal expansion, .00002 cm. per cm. per degree C. (.000011 inch per inch per degree F.).

This low coefficient of expansion is, of course, desirable in numerous applications such as pulleys, rollers, panels, antennae mounts, and close fitting machined parts . . . wherever dimensional accuracy must be maintained. It is important in non-structural parts—insulation for radio and electrical devices; for example, in high frequency coils where accuracy of diameter is necessary to hold inductance values to close limits.

Another point about Synthane worth remembering is that its coefficient of expansion corresponds closely with aluminum and aluminum alloys so that wherever Synthane is constrained by attachment to these metals, there is little or no tendency to set up internal stresses with changes in temperature.

In addition to retaining its shape, Synthane retains to a practical degree other desirable characteristics, notably resistance to corrosion, mechanical strength and dielectric properties.

Effects of Higher Temperatures

Various grades of Synthane have been tested under three time-temperature sets of conditions—exposures of 10 months at 250° F., 48 days at 320° F., and 24 hours at 400° F.* From these tests the following general conclusions may be drawn:

TENSILE STRENGTH is reduced by exposure to heat but may be held within reasonable limits by the use of glass fabric base (GLF) or asbestos fabric base (AA) grades or through the use of the following melamine resin grades, GLMF (glass fabric), XKM (hard kraft paper) or LM cotton fabric base.

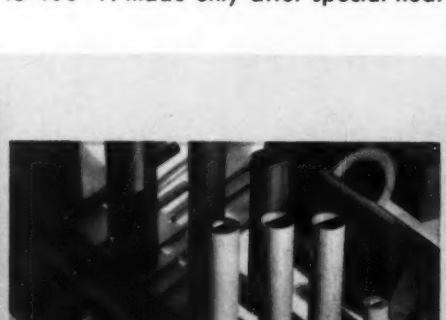
WATER ABSORPTION—In other tests tensile, flexural and compressive strengths were observed to decrease from 10 to 25% at temperatures of + 150° to + 175° F., but to increase a similar amount at temperatures from − 50° to − 75° F. Impact strength, on the other hand, was found to increase from 20 to 40% at + 150° to + 175° F. and decrease a similar amount from − 50° to − 70° F.

The 24-hour water absorption of Synthane is not affected by heat treatment except after long periods of exposure. The long temperature cycle (10 months at 250° F.) would substantially increase water absorption in the fabric base grades although we know of no such continuous exposure conditions in aircraft practice.

HARDNESS of fabric grades decreases slightly with heat treatment, whereas paper base grades usually become harder.

DIELECTRIC STRENGTH is virtually unaffected by any of the time-temperature conditions noted.

*Exposure to 400° F. made only after special heat treatment.



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SYNTHANE

SHEETS-RODS-TUBES-FABRICATED PARTS-MOLDED-LAMINATED-MOLDED-MACERATED

SYNTHANE CORPORATION, OAKS, PENNA.

REPRESENTATIVES IN ALL PRINCIPAL CITIES

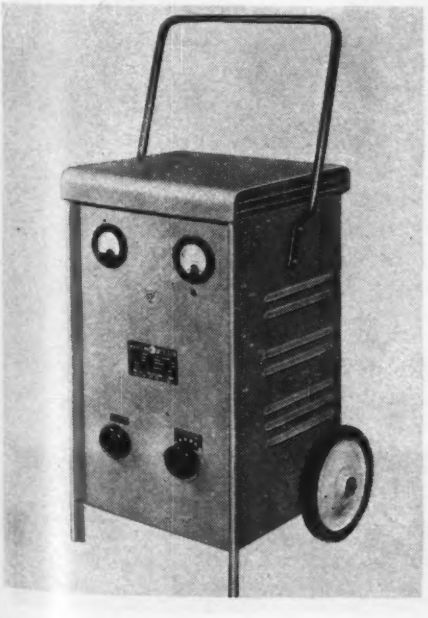
Plastic Grommets 80

Creative Plastics Corp., Brooklyn, N. Y., has put on market four standard sizes of all-phenolic plastic grommets

for radio, motor, and electronics equipment. Holes are concentric and corners chamfered. Threads are lubricated and unit entirely matte finished.—AVIATION, *Dec.*, '43.

Rectifier 81

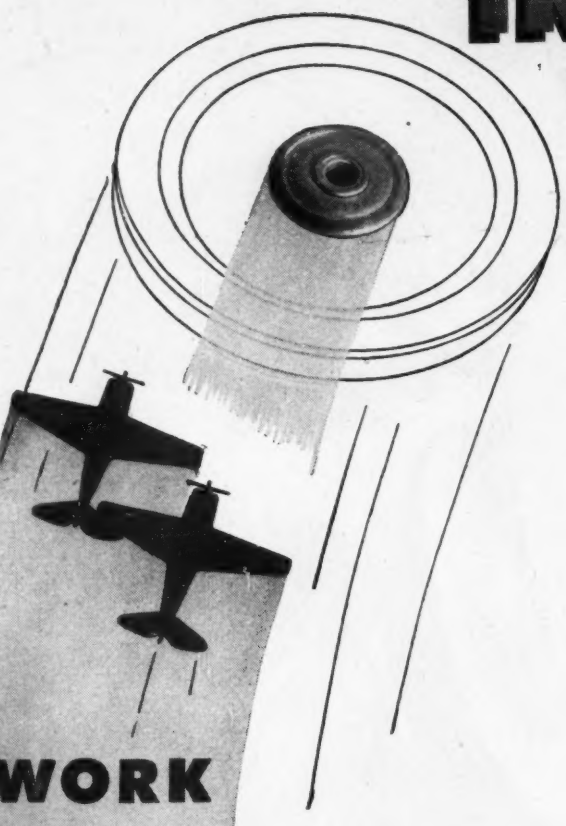
Rating of new line of rectifiers found useful for aircraft engine starting and testing of radio and electronic equipment is from 65 to 500 amp. at 6, 12, 24, 36, and 48 v. in various models; power output is 4,500 w. Fractional horsepower ventilating fan motor is only moving part in portable cabinet weighing 206 lb. and measuring 16x16x29 in. Current, says **W. L. Maxon Corp.**, New York City, is supplied by self-healing magnesium-copper-sulphide rectifying stacks. —AVIATION, *Dec.*, '43.



Setting Our Standard High!
We live in an age of routine miracles—gigantically planned to meet the supreme challenge of wartime necessity. Permoflux Dynamic Headphones have cast their outline in the progress of communications—have attained a performance standard of unmatched efficiency and complete dependability. The horizons of tomorrow will spotlight the Permoflux developments of today!
Buy WAR BONDS For Victory!
TRADE MARK
PERMOFLUX
CORPORATION
4916-22 W. Grand Ave., Chicago, Ill.
PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

INSUROK

Precision Plastics and NICE Bearings



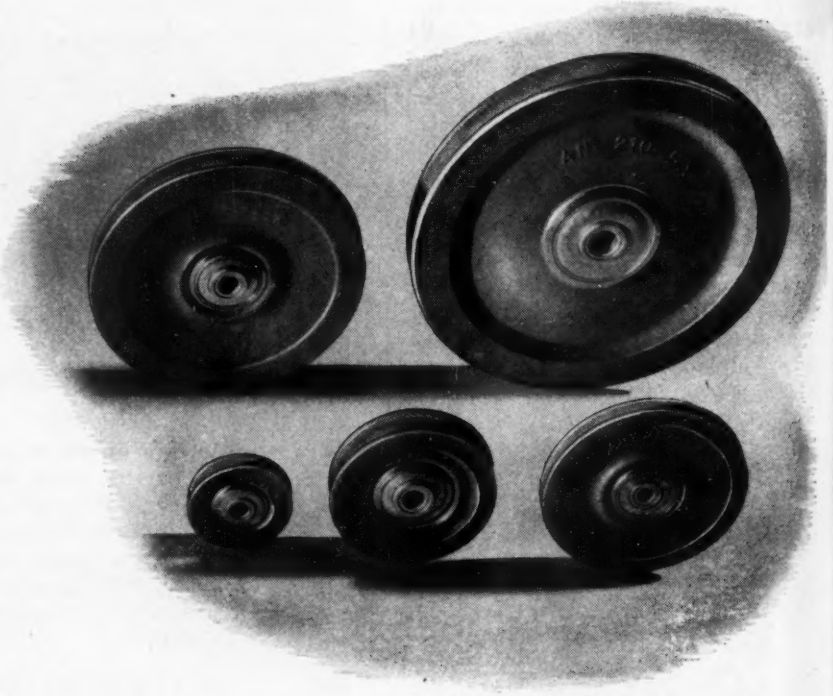
TEAMWORK DOES IT!

NICE BEARINGS AND INSUROK have teamed up for the duration.

There are no individual aces in this war. On the fighting front, flyers pair up for mutual benefit—protect each other in combat.

In making vital parts for aircraft, too, teaming up is essential. NICE Ball Bearings and INSUROK, for example, are working together to supply pulleys for some of our fastest fighters.

NICE Aircraft Bearings, because of their flawless precision manufacture, and INSUROK, because of its light weight, strength, and machinability to extremely close tolerances, are giving reliable, dependable service in combat . . . hastening Victory over the Axis.



The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
DETROIT OFFICE: 4-252 G. M. BUILDING, DETROIT 2, MICHIGAN NEW YORK OFFICE: 75 WEST STREET, NEW YORK 6, N. Y.

CLEATS FOR FROZEN FIELDS

HERE'S another outstanding Firestone contribution to flying safety — the Firestone CLEATED Channel Tread Tire! Already widely acclaimed for making possible landings and take-offs on soft, muddy fields, the Firestone Channel Tread Tire now adds to its accomplishments safety in high speed landings on dangerous, icy surfaces. Sturdy, built-in, steel disks with sharp facings dig in and take hold immediately on impact of landing to provide positive traction on the smoothest ice.

Of added importance, these skid-preventing cleats may be inserted or removed in a matter of minutes. Tests under the most severe operating conditions prove definitely that the Firestone Cleated Channel Tread Tire provides performance superior to any other ice tire.

This is only one of a long list of Firestone contributions to aviation. And whether your problem is one of development, design or volume production — whether your requirements are made of rubber, metal or plastic — a Firestone engineering representative is available on request.

Listen to the Voice of Firestone with Richard Crooks and the Firestone Symphony Orchestra, Monday evenings over N. B. C.

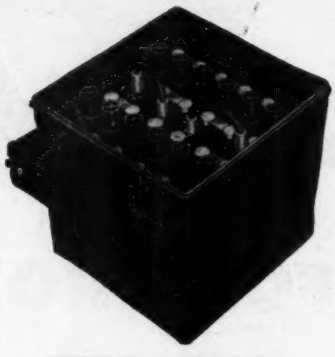
Firestone

AIRCRAFT COMPANY

SHIP BY AIR

Copyright, 1943, The Firestone Tire & Rubber Co.

GOULD FACTORY-BACKED SERVICE AT KEY POINTS AVOIDS COSTLY DELAYS, MAKES QUICK REPAIRS POSSIBLE



• Speed is the essence of today's production efforts. This has added new strains on men and equipment. In hurrying to make delivery dates machines are forced to new highs, with the result that breakdowns and accidents do occur. Storage batteries are no exception to this rule.

Realizing the need for quick repairs Gould has created a special factory-backed service at key points throughout the United States. Through the completeness of Gould equipment, and the know-how of the eight Gould factories, injured batteries will again be on the firing line as good as new, with a minimum of delay.

Specify GOULD Batteries

Designed especially for aircraft service. Supplied either wet and charged, or dry charged. Engineers are invited to consult us for design or other special services. Write Gould at Depew, N. Y.

GOULD STORAGE BATTERY CORPORATION, DEPEW, NEW YORK

Builders of industrial batteries for every application. **Sales and service offices in principal cities of the U.S.A.**

Factories at Depew, N. Y., North Bergen, N. J., Dallas, Atlanta, Chicago, St. Paul, Leavenworth, Los Angeles

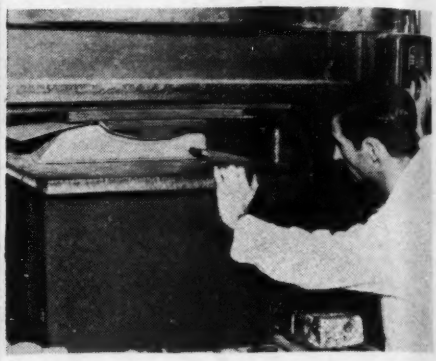
FOR EXCELLENCE IN STORAGE BATTERY PRODUCTION AT DEPEW PLANT

GOULD

Since 1898 THE BATTERY PICKED BY ENGINEERS

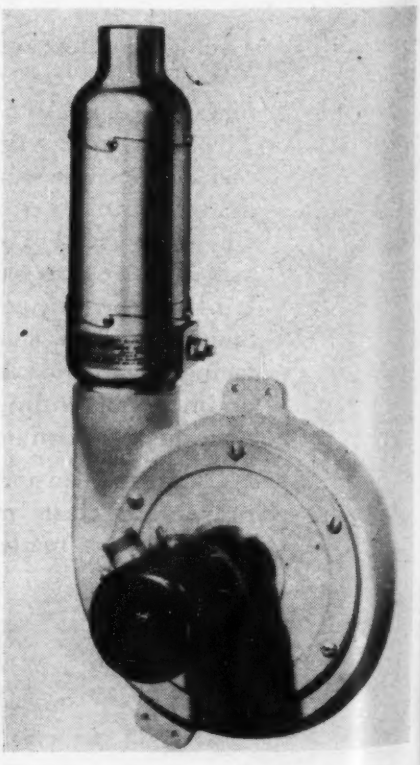
Forming Sheets **82**

Announcement is made by **Los Angeles Standard Rubber Co.**, of new X-84 rubber stock forming sheets that give increased service is hot magnesium forming. Sheets are reported to have been in service for 200 cycles, or five to ten times number possible with former stocks. Reports indicating excellent service in steam to 325 deg. F. for extended periods are also on file. X-84 is resistant to tearing and smudging when used in magnesium hot press forming.—AVIATION, *Dec.*, '43.



Heater **83**

Capable of delivering between 600 and 6,000 Btu. per hr. for defrosting aircraft windows and warming instruments and compartments, new heater has element wound on ceramic core and two-piece aluminum shell. Blower or ram duct circulates air. Heater operates on 24-28 v. d.c. circuit. It is manufactured by **Avia Products Co.**, Los Angeles.—AVIATION, *Dec.*, '43.



SIMPLIFY QUALITY CONTROL with easy-to-analyze x-ray inspection

Quality control of castings and weldments is easy; fast and absolute with x-ray inspection.

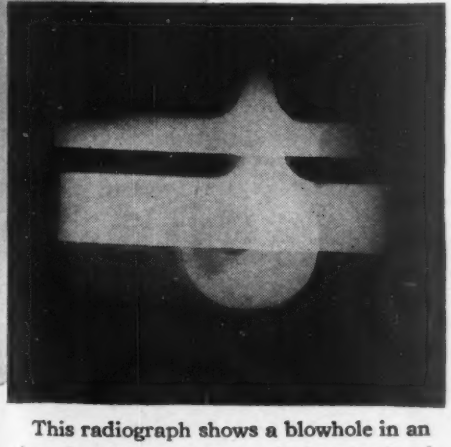
For example, suppose you have a casting that must be perfected before large scale pourings are practical. All you have to do to perfect quality is make small test casts—x-ray them—and you have an easy-to-analyze picture that shows up such variables as temperature of pour, location of gates and risers, ramming and shrinking.

Once perfected, an occasional x-ray is all that is necessary to maintain quality control—for there is no need for routine examination of every piece. Workmen learn quickly and pictorially the advantages and disadvantages of each modification in metal working procedures. And you make each test of quality absolutely —nondestructively.

Above all, you have pictorial proof for your customers that your products meet their established standards. No arguments—no renegotiations—no excuses.

X-ray is at work on hundreds of war jobs—saving machine and man-hours, conserving critical materials, speeding production, controlling quality and helping train workers. For more information, write for B-3159. It's a simplified booklet that shows you how and where x-ray can be used in industry. J-02024

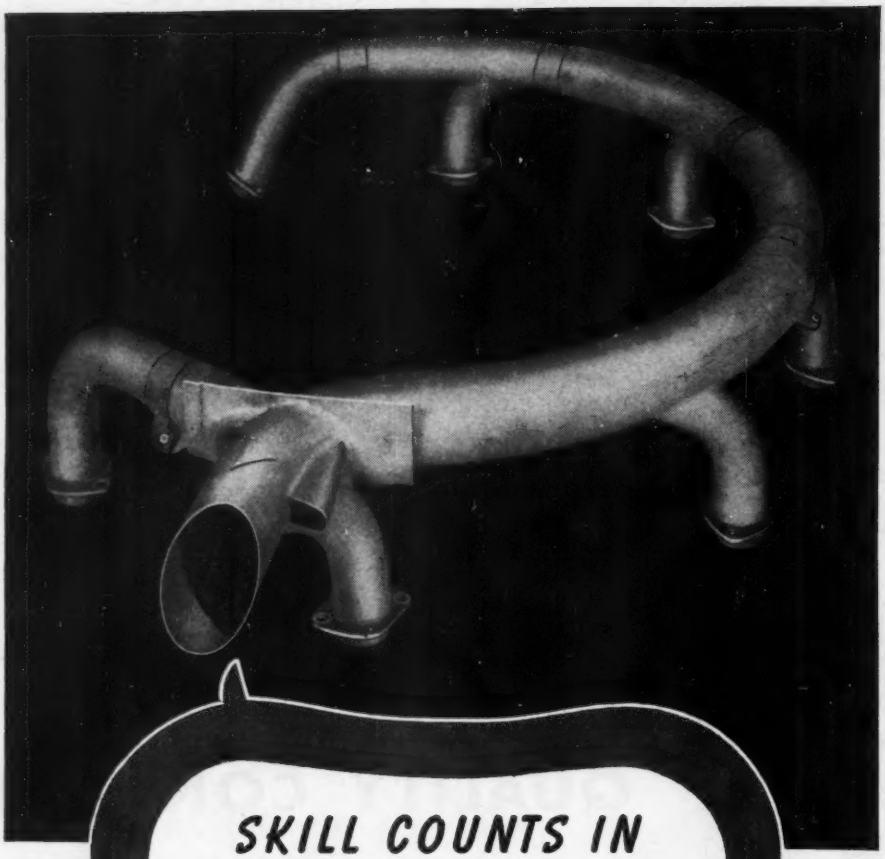
LOOK INSIDE WITH X-RAY



This radiograph shows a blowhole in an aircraft casting . . . a typical example of how x-ray reveals subsurface defects.

Westinghouse INDUSTRIAL X-RAY

PLANTS IN 25 CITIES.. OFFICES EVERYWHERE



SKILL COUNTS IN AIRCRAFT WELDING

★ Kay Products Company occupies a unique position in the aircraft industry. Organized more than five years ago for the sole purpose of serving the Army Air Forces and leading airplane manufacturing companies, it has developed men and facilities for the production of aircraft parts and assemblies. Welding technique, particularly, has been carried to a high degree—and through recent increases in facilities and personnel, *we now offer the welding experience of this company to a limited number of new customers.*

KAY PRODUCTS COMPANY

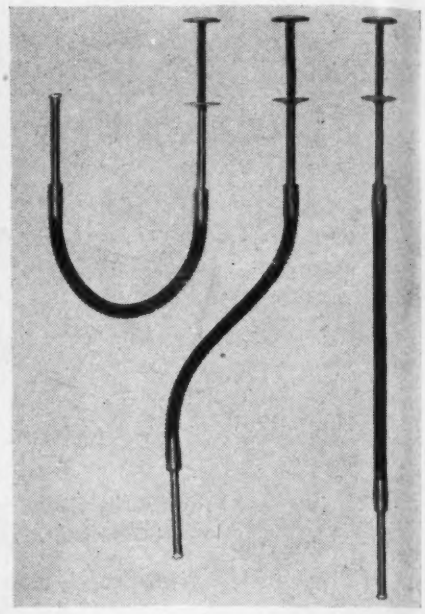
4825 CABOT STREET, DETROIT, MICHIGAN

DIVISION OF TYLER FIXTURE CORP., NILES, MICH.

AIRCRAFT WELDING

Holder, Retriever 84

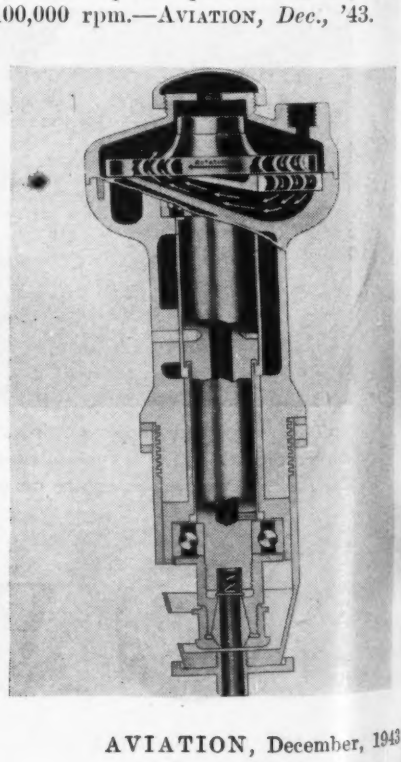
Pressing down button on end of this 18-in. flexible shaft opens claws at other end for picking up small parts or setting



screws in inaccessible places. Manufactured by **New Britain Machine Co.**, New Britain, Conn.—AVIATION, *Dec.*, '43.

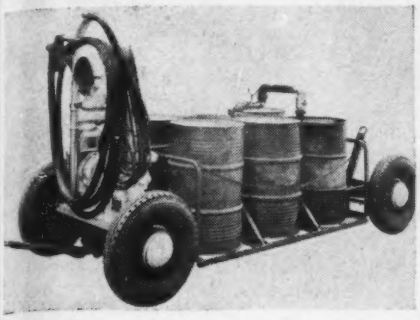
Air Turbine 85

Data on air motor developed for its own products is being released to other manufacturers by **Onsrud Machine Works**, Chicago. Patented, solid milled rotor operates on impulse reaction principle with air feed-back system. It has bucket impeller blades. Company has used this type motor in power range of 1/6 to 3 hp. at speeds from 15,000 to 100,000 rpm.—AVIATION, *Dec.*, '43.



Gas Dispenser 86

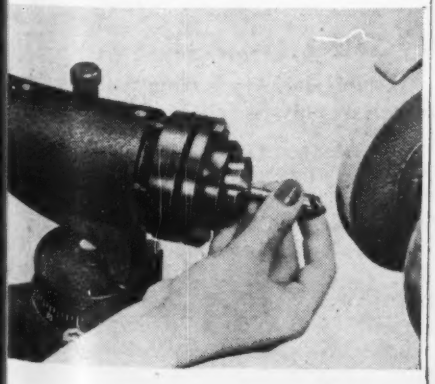
New six-barrel, four-wheel, portable oil and gasoline dispensing unit for in-the-field servicing of aircraft is announced by **Harman Equipment Co.**, Los Angeles, Calif. It will handle gaso-



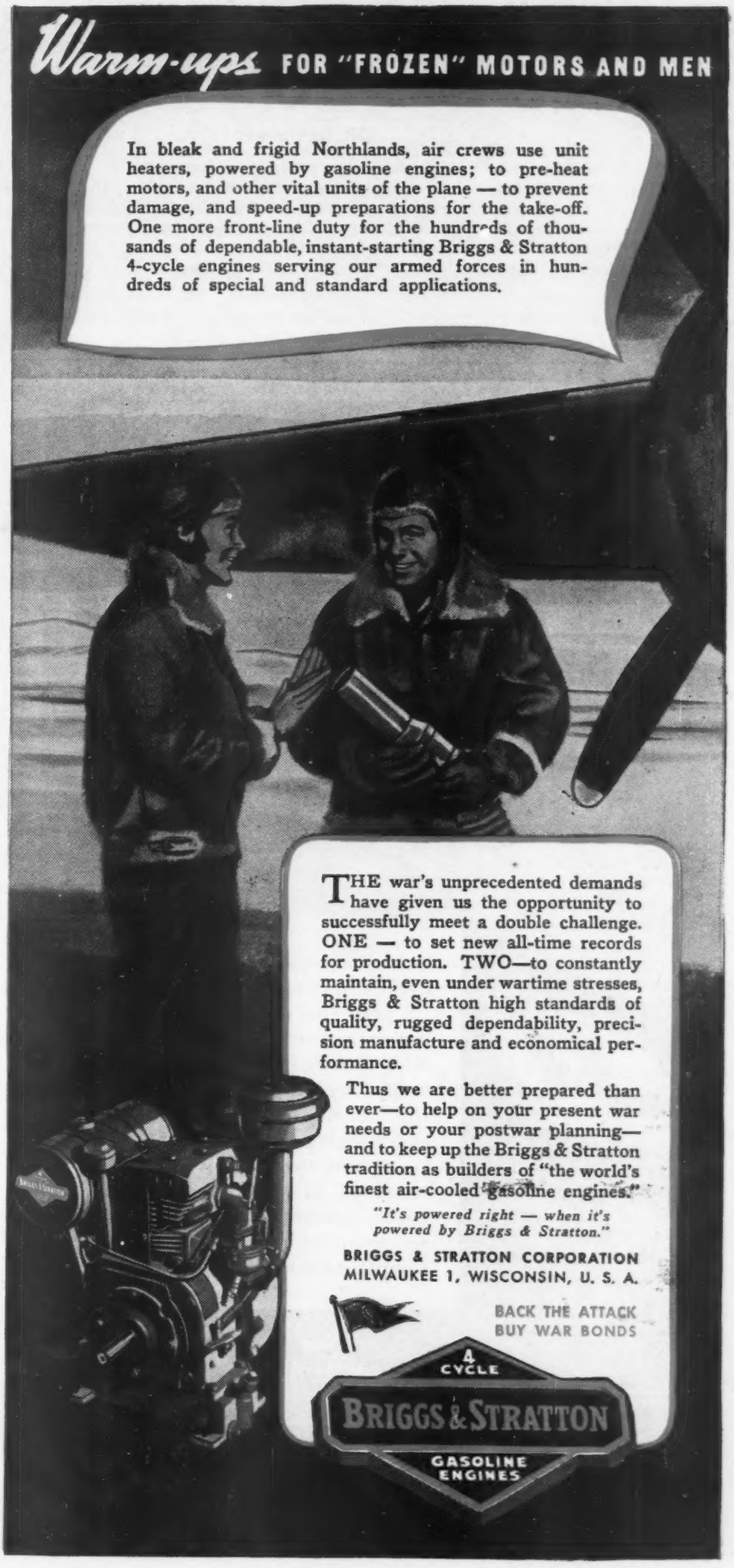
line, diesel, and other light fuels at maximum pump capacity of 15 gpm. at all prevailing atmospheric temperatures. Frame is welded into a single, rigid unit mounted on automotive type disk wheels with heavy roller bearings and pneumatic tires. Hinged tractor hitches at both ends permit four-wheel steering and extra short turning. Low trainer beds enable one man to load or unload drums. Pump and meter units are demountable and powered by electric motors or gasoline engines. A double-swing, flexible suction arm assembly reaches all barrel openings. Electric heating elements are available as extra equipment. Classed as Series 1000, unit is known as Harmeco Lube-A-Plane.—AVIATION, *Dec.*, '43.

Relief Grinders 87

Manufacture of I-G-C countersink relief grinders is announced by newly formed **Accurate Machine Products Co.**, Los Angeles. New fixture fits any standard grinding machine and will take work from 1/16 to 1 in.-dia., handling countersinks of all types, center drills, and either right- or left-hand pilot drills. Main housing is cast iron which supports a hardened and ground spindle on two large bearing surfaces requiring only



periodic oiling. Cam is hardened tool steel with steel adjustment pins.—AVIATION, *Dec.*, '43.


Warm-ups FOR "FROZEN" MOTORS AND MEN
In bleak and frigid Northlands, air crews use unit heaters, powered by gasoline engines; to pre-heat motors, and other vital units of the plane — to prevent damage, and speed-up preparations for the take-off. One more front-line duty for the hundreds of thousands of dependable, instant-starting Briggs & Stratton 4-cycle engines serving our armed forces in hundreds of special and standard applications.
THE war's unprecedented demands have given us the opportunity to successfully meet a double challenge. ONE — to set new all-time records for production. TWO—to constantly maintain, even under wartime stresses, Briggs & Stratton high standards of quality, rugged dependability, precision manufacture and economical performance.
Thus we are better prepared than ever—to help on your present war needs or your postwar planning—and to keep up the Briggs & Stratton tradition as builders of "the world's finest air-cooled gasoline engines."
"It's powered right — when it's powered by Briggs & Stratton."
BRIGGS & STRATTON CORPORATION
MILWAUKEE 1, WISCONSIN, U. S. A.
BACK THE ATTACK
BUY WAR BONDS
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

Wire Dies 88

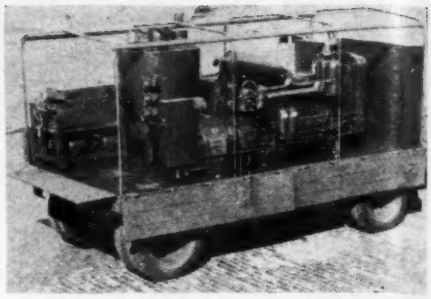
Round-hole cored dies for producing fine wire are being stocked by **Carboloy Co.**, Detroit, in sizes from .004 to .007 in. thus eliminating need for piercing by user. Dies have standard R-2 Carboloy nibs and casing sizes of 1 in. or 1½x9/16 in.—AVIATION, *Dec.*, '43.

Wire Coloring 89

Colored chemical coatings, which dry in about 1 min., are announced by **Sterling Varnish Co.**, Haysville, Pa., for identifying electric wires. Wires are drawn through coloring, a varnish known as S-184, or dipped in it.—AVIATION, *Dec.*, '43.

Oil Reclaimer 90

Portable oil reclaimer being used in battle theaters has standard unit built by **Youngstown-Miller Co.**, Sandusky, Ohio, diesel generating set, clean oil storage tank, and waterproof bins for filter papers and refinery earth used in cleaning process. Oil is pumped from drums on ground into heating unit from



which thermostat releases it into transfer tank. From here it is forced by compressed air through two-stage filter and thence to receiving drums. Used oils are said to be restored to substantially their original values of fire, flash, viscosity, color, and neutralization number.—AVIATION, *Dec.*, '43.

Temperature Indicator 91

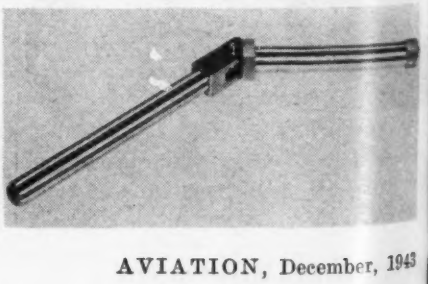
Moisture-sealed mercury thermostat tube is activating part in new temperature indicator. It measures to 1 deg. F. when threaded into cylinder head or coolant or oil line. Thermometer is connected to two indicator lights; when temperature is normal, green one glows. When temperature goes above normal, red light flashes; and at dangerous heat, red stays lighted. Available ranges for oil, Prestone, or other liquids or gases are —60 to +500 deg. F. Maker is **Vapor Car Heating Co.**, Chicago.—AVIATION, *Dec.*, '43.

Boring Tools 92

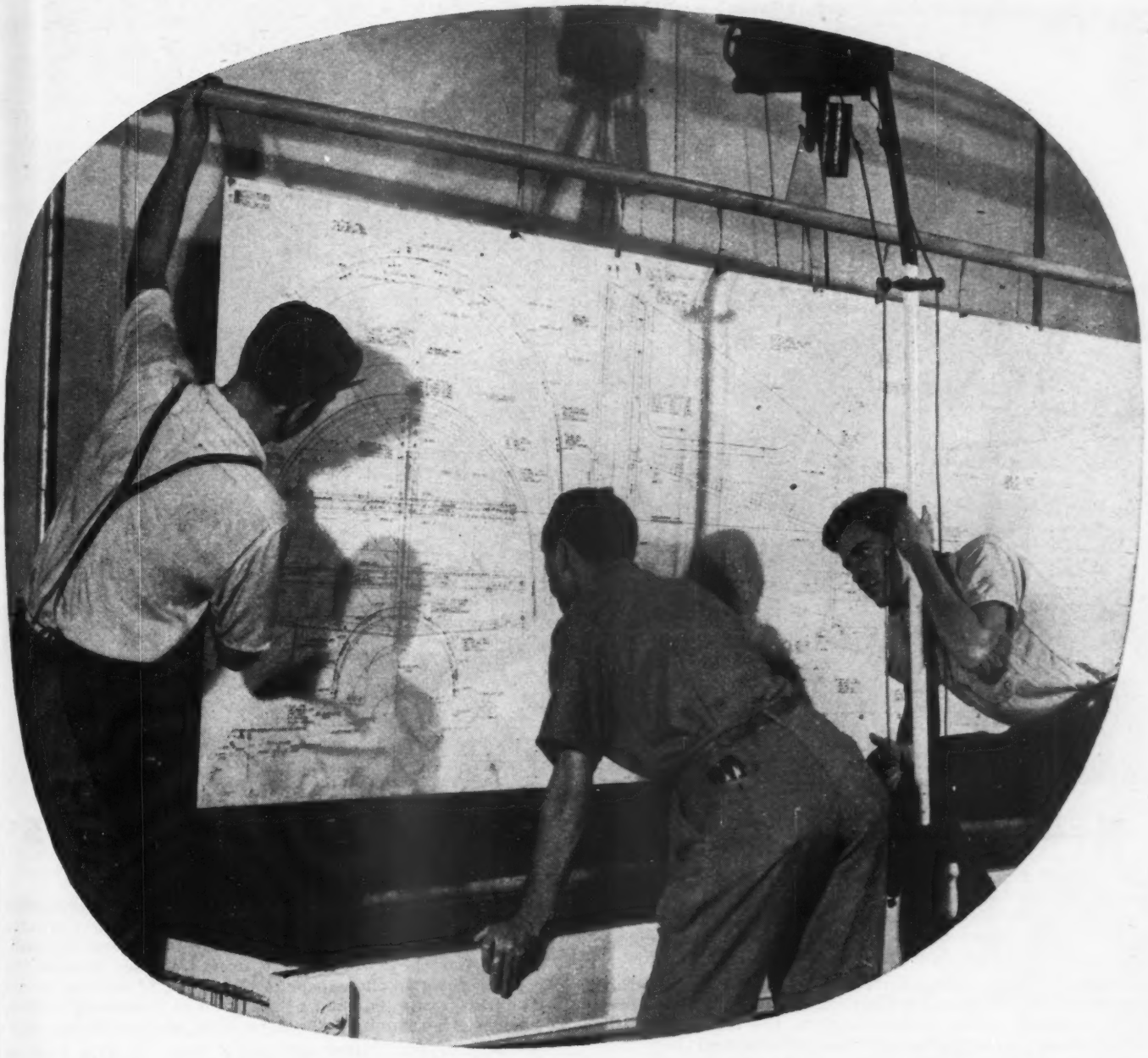
Solid round blanks that user once had to grind himself are now being supplied ready finished in two models: 27SR with side cutting edge angle 30 deg., and cutting edge 38 deg. for 30 deg. boring bar; and 29SR with side and end angles of 45 and 53 deg. for 45 deg. boring bar. Tolerances on diameter are given as + .000 and — .001 in., on other dimensions as + .000 and + .005 in. Sizes furnished in each style by **Kennametal, Inc.**, Latrobe, Pa., are 3/32, ⅛, 5/32, $\frac{3}{16}$, and ¼ in.—AVIATION, *Dec.*, '43.

Key Setter 93

Machine steel key setting tool for aircraft assembly is obtainable in three sizes, No. 6, 8, and 10. It has cam mechanism, and when lever is opened tool advances and makes keyway.—AVIATION, *Dec.*, '43.



Strength, toughness and minimum weight forgings ... parts that must stand up under unpredictable loads. WYMAN-GORDON skilled workers are producing reliable forgings for every high-powered aircraft ... around the clock ... determined to keep up high speed, accurate production so essential to freedom's complete mastery of the air.
WYMAN-GORDON
Forgings Laboratory Controlled
WORCESTER, MASS.
HARVEY, ILL.
DETROIT, MICH.



master patterns STAY SHARP on this metal

More and better warplanes every month is no easy assignment for aircraft manufacturers. Yet the job is being done, thanks to faster production methods from the drawing board to the assembly line.

Template-reproduction (once drawn by hand) is a good example. Many designers are specifying ARMCO Galvanized PAINTGRIP sheets for their master patterns. Copies are made in a few minutes by the photo-loft or the electrolytic processes. Valuable time is saved and hundreds of designers are released for other important work.

ARMCO PAINTGRIP sheets are used for master templates because scribed lines won't flake or fade. This mill-bonderized metal takes and holds paint indefinitely. Lines stay sharp in copy after copy, leaving no chance for errors. And PAINTGRIP sheets are smooth, flat and easy to work.

Do you want these advantages of ARMCO PAINTGRIP for *your* master template work? For complete information about PAINTGRIP, write to The American Rolling Mill Co., 2631 Curtis Street, Middletown, Ohio.

GALVANIZED PAINTGRIP • ARMCO • IRON OR STEEL

THE AMERICAN ROLLING MILL COMPANY

HELP KEEP "HELLCATS" COOL FOR HOT PILOTS

The newest Navy fighter, the "Hellcat", is a direct descendant of the Wildcat,—also a famous Grumman fighter. Reports say the Hellcat flies straight and true, has dazzling rate of climb, plenty of speed and lots of high-altitude performance—qualities that "hot" (ace) pilots demand.

Helping the Hellcat range farther than any Navy fighter has ranged before, Winchester Cartridge Core Radiator Tubes in its vital oil-cooling system bring to the Hellcat . . . protection from corrosion, high-efficiency cooling and the sturdiness to stand up under the extreme cold of super altitudes.

Made of pure copper, with walls only 6/1000ths of an inch thick, Winchester Radiator Tubes, thanks to Winchester's COLD copper-extrusion process, are seamless and so assembled that *their entire outer surface is cooling area.*

WINCHESTER RADIATOR TUBES RESIST CORROSION . . . DEFY BURSTING. Pure copper, Winchester Cartridge Core Tubes will not corrode under regular operating conditions. And they won't burst from freezing, because the coolant flows on the *outside* of the tubes. If freezing should compress a tube, causing a "set" and so restricting air flow, passing a rod through it restores it to normal shape.

IF WOUNDED THEY QUICKLY FLY AGAIN. Pictures below show how to replace Winchester Cartridge Core Tubes should they be punctured in action or by accident. They explain, too, why millions of Winchester Cartridge Core Tubes are used to keep planes, and tanks in constant action.

HARDER JOBS WANTED FOR THESE SENSATIONAL TUBES

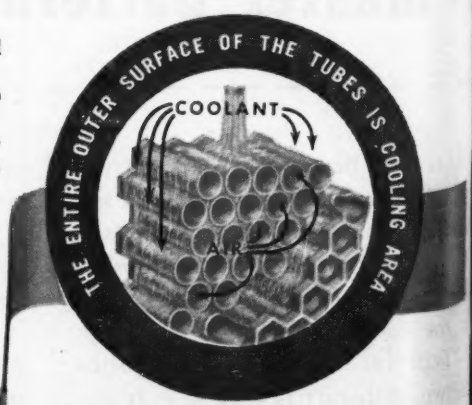
No war baby, Winchester Cartridge Core Tubes have 25 years of service behind their performance. They offer these spectacular features:

- Of pure copper, thus corrosion-proof.
- Seamless,—safe against leaks.
- Coolant on *outside*—no damage from freezing.
- 1,728 cartridge core tubes per square foot.
- Avoid waste space in radiator assembly — minimum of solder.
- Permit tailoring radiator, to fit any dimension or design.
- Provide up to 25% greater cooling per square foot.

WINCHESTER REPEATING ARMS COMPANY
New Haven, Connecticut
Division of WESTERN CARTRIDGE COMPANY

WINCHESTER
TRADE MARK REG. U. S. PAT. OFF.
"On Guard for America Since 1866"

Damaged tubes are pushed out. New Tubes are inserted. Soldering completes repair.



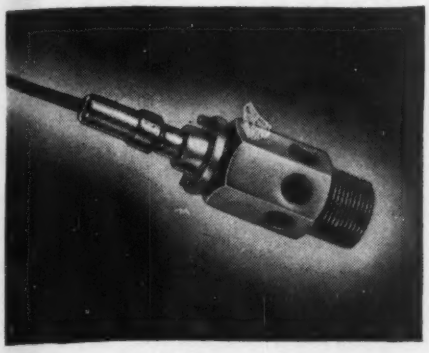
If out of your engineering knowledge, experience, research and skill you are contemplating a new fighting machine for Uncle Sam . . . are dreaming up a startling new post-war automobile, or similar product, write Desk C Radiator Division, Winchester Repeating Arms Company, New Haven, Connecticut.

COPR., 1943, WINCHESTER REPEATING ARMS CO., DIV. OF WESTERN CARTRIDGE CO.

RIFLES • SHOTGUNS • CARTRIDGES • SHOTSHELLS • CARTRIDGE CORE RADIATOR TUBES • FLASHLIGHTS • BATTERIES

Pick-Up 94

Ordinary socket wrench is reported sufficient to install and remove new type pick-up from aircraft engines. It has



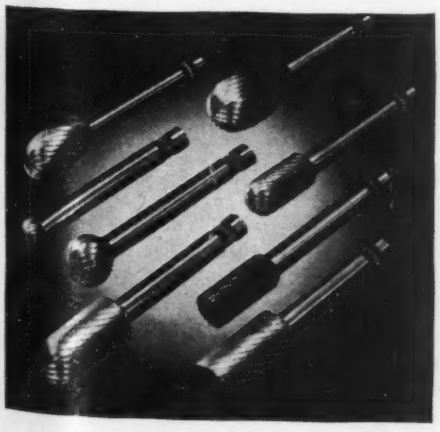
been designed for analyzing detonation and compression conditions and for actuating cathode ray oscillographs when rating fuels. Special coil impregnation has been made to withstand operating temperatures of 350 deg. F. Bayonet socket connects cable to pickup, and two set-screws are used in place of usual hexagonal nut attachment. Unit is in production by **Electro Products Laboratories**, Chicago, under designation No. 3000B.—AVIATION, *Dec.*, '43.

Pay-Offer 95

Wood and fiber calculator devised by **Berger-Brickner Co.**, Los Angeles, Calif., figures pay for straight and overtime of more than 40 hr. in one operation or as separate items. Rate is 40c. to $1.74 with ½c. spread and time range up to 80 hr. with 6- and 15-min. divisions.—AVIATION, *Dec.*, '43.

Rotary Files 96

Three new shapes have been added to original line of ball-end type cemented carbide rotary files produced by **Carbur, Inc.**, Lincoln Park, Mich. Each shape is furnished in two sizes. With cutting teeth ground from the solid, these files, it is said, can be run faster and longer. They also reduce burring time, states maker, and need replacement less frequently.—AVIATION, *Dec.*, '43.

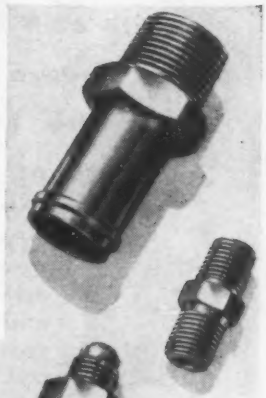


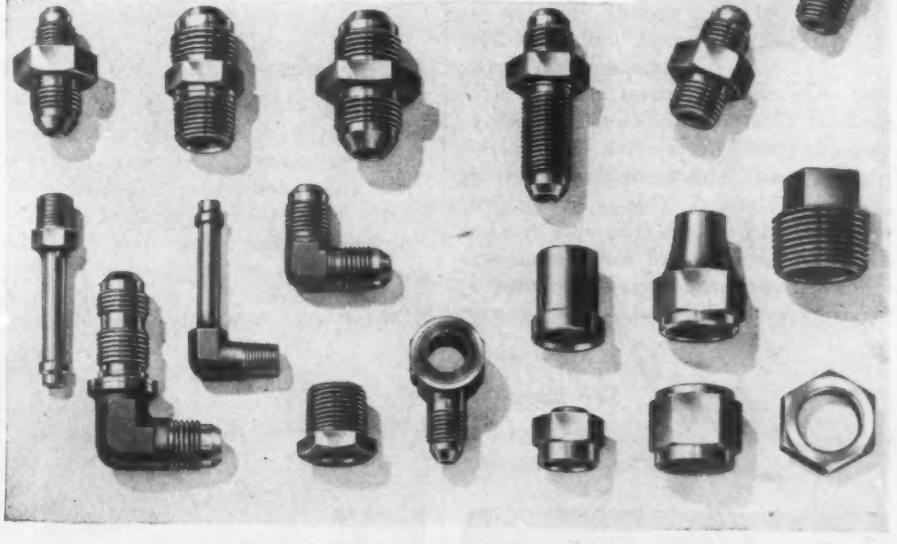
The "Know-How" and the Equipment to produce "AN" Standard Fittings

For well over 60 years Grinnell has been producing fittings for tubing and pipe in sizes from ⅛" to 24" diameter.

This "Know-How", plus up-to-the-minute production equipment, means the ability to turn out *precision* "AN" fittings in war-demand quantities.

We may be able to help you cut down assembly delays. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island.





GRINNELL

WHENEVER PIPING IS INVOLVED

Plants, Branch Warehouses and Sales Offices in Principal Cities.

...with X-RAY

—the modern way to study the internal effects of heat

For example, women welding trainees could not understand how varying degrees of heat affected welds ...classroom discussion only confused them more. Welds made at different current settings were x-rayed. Heat effects were visually revealed... easily understood... training greatly accelerated. This is but one of hundreds of everyday jobs that can be done faster, better and for less money with Westinghouse X-ray—the modern versatile production tool. J-02021

More dope? See page 257

Westinghouse X-RAY

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Vibration Tester 97

For recording vibrations in aircraft testing and on motors and generators, device developed by **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, can be

laid on object being tested or juxtaposed to it by a prod. Vibrations from 60 to 15,000 cycles per min. are recorded on a celluloid tape. Weight of tester is 8½ lb.—AVIATION, *Dec.*, '43.

Crate Sealer 98

Wishnick-Tumpeer, Inc., New York City, is marketing substance to be used as a sealer in shipping cases which often shrink and open up in transit. The material, called Witco Mastic No. 224, can be applied with rake, trowl, or spray gun. It is a dry, semi-hard material said not to become particularly brittle at low temperatures or flow excessively up to 130 deg. F.—AVIATION, *Dec.*, '43.

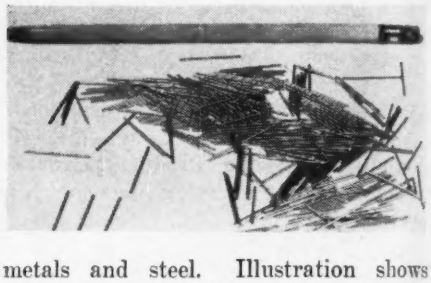
Cargo Loader 99

Scissor lift is activated by twin hydraulic cylinders in new truck for loading cargo planes. Cylinders, controlled from either cab or body, lift body vertically to maximum height of 10 ft. or any intermediate level. Lowered height is 4½ ft. Normal payload is 5,000 lb., maximum 8,000 lb. It has been built by **Heil Co.**, Milwaukee, to operate in

temperature range of −50 deg. F., to + 160.—AVIATION, *Dec.*, '43.

Tungsten Alloy 100

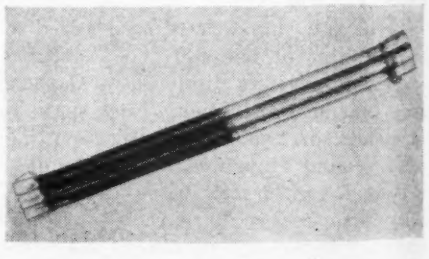
For use in instrument bearing pivots, needle valves, etc., new alloy of tungsten chromium, and cobalt has been developed by **Haynes Stellite Co.**, a unit of Union Carbide & Carbon Corp., New York City. It is cast close to desired size and finished by grinding and lapping. Properties reported: Tensile strength approximately 65,000 psi., Rockwell hardness C-60 to C-62, low coefficient of friction, susceptibility to high polish, and resistance to corrosion from atmosphere and water solutions of salts, alkalis, and acids. Non-magnetic, it has proven useful in compasses and can be brazed or welded to other base



metals and steel. Illustration shows comparative size of pins of this material centerless ground for instrument pivots and pivot tips.—AVIATION, *Dec.*, '43.

Cooler Cleaner 101

Right portion of aircraft oil cooler tubes in photo was soaked 15 min. in cleaning solution No. 786, rinsed in tap water, and air-dried. Use of this cleaner is reported to eliminate need for steam,



soda, or acid. It is simply circulated through tubes at room temperature for an hour following flushing with Stoddard solvent. Cleaning time is thus cut, according to **Magnus Chemical Co.**, Garwood, N. J.—AVIATION, *Dec.*, '43.

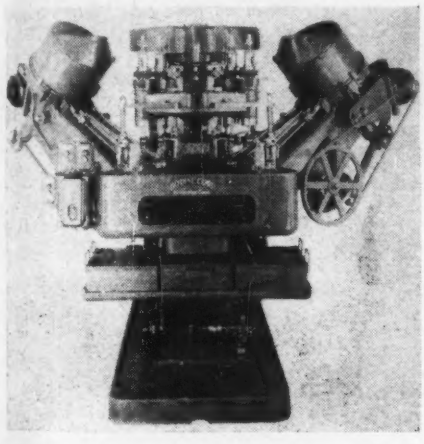
Plastic Material 102

"Compars" is name given new plastic derived from compounded polyvinyl alcohol resin by **Resistoflex Corp.**, Belleville, N. J. Available in transparent, flexible, and solution forms, it is termed more wear-resistant than rubber and specially solvent proof. Described as highly inert, it is being used in hose car-

rying high octane aviation fuels. Other varieties of product have been found flexible in temperature range of −70 deg. F. to +300.—AVIATION, *Dec.*, '43.

Nut Tapper.....103

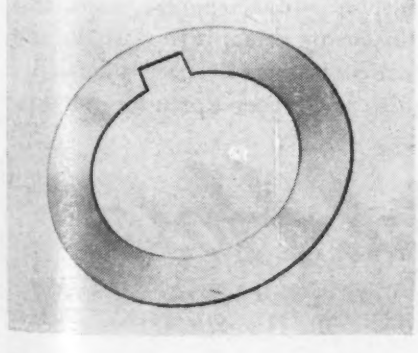
Two hopper feeders having two adjustable chutes each are reported to enable automatic tapping of four nuts simultaneously at four stations on machine manufactured by **The Bodine Corp.**, Bridgeport, Conn. Two sizes of nuts can be tapped at the same time and, after each stroke, each of four produced is discharged into a separate collecting box. Two sizes of machine are available for nuts including ¼ in.—28 and ½ in. −20. Spindle is driven by gears. Addition of automatic indexing dial per-



mits countersinking, drilling, and counterboring. Larger model occupies floor space 80 in. sq. and smaller, which, for example, can tap 160 10/32 in. nuts per minute, takes 80x55 in.—AVIATION, *Dec.*, '43.

Arbor Spacer.....104

Added to line of arbor spacers is new .0015-in. metal type to permit setting of



"THE GOOD MECHANIC'S CHOICE"

A couple of "Cuties" with tremendous power

United States Special Streamlined Aviation Drills

for use in cramped quarters

Don't let their "daintiness" fool you. They're no "powder puffs" . . . but surprisingly strong in proportion to their size and designed to give plenty of leverage and power where cramped quarters require "pint size" and "featherweight."

Speeds from 550 to 5,000 r.p.m. Equipped with 3-jaw screw-back chuck; 7 ft. 3-wire rubber covered cable, indestructible rubber attachment plug.

U. S. Also Makes:

DRILLS • DRILL STANDS • VALVE SEAT GRINDERS
VALVE REFINISHING MACHINES AND SHOPS
PORTABLE SURFACERS • PORTABLE SANDERS
FLEXIBLE SHAFT MACHINES • LATHES GRINDERS
GRINDERS • BUFFERS • POLISHERS

THE UNITED STATES ELECTRICAL TOOL CO.
CINCINNATI, OHIO, U.S.A.

Photo by Office of War Information

PROTECTING THE "Nerve Center" OF A B-25 BOMBER

The young lady is attaching terminals to the panel of an electrical junction box, shortly to become the "nerve center" for a big B-25 bomber. To protect against static interference, incoming and outgoing wiring is encased in Flexible Low-Tension Shielded Conduit made by American Metal Hose.

Wherever planes fly, this battle-tested conduit is playing its part in supporting brilliant performance... enabling radio signals and directions to come in clear and undistorted. It is one of the important "tremendous trifles" that are helping American wartime aviation set so many outstanding records.

American Metal Hose makes a complete line of fittings and accessories for American Flexible Low-Tension Shielded Conduit. Both fittings and conduit conform to A-N, A-C and NAF specifications. We are also prepared to make complete assembly of conduit and fittings to meet individual specifications, thus conserving valuable time on the production line for aviation plants. Inquiries will receive prompt attention.

43188

ANACONDA **American Metal Hose**

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Conn.
Subsidiary of Anaconda Copper Mining Company • *In Canada:* ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*

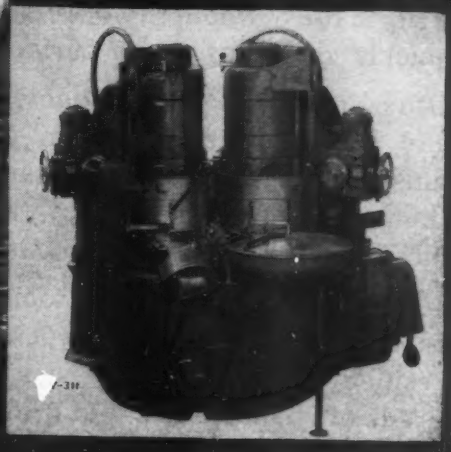
"PUT IT ON THE BLANCHARD"

These heat treated steel trunnion bearings are ground on a No. 16-A2 Blanchard Surface Grinder.

They are loaded on special 80-station fixture with magnetic studs locating from previously ground surface. The end of the bearing is then ground to very close limits. At the unloading station the work is automatically ejected and demagnetized.

.005" to .015" of stock is removed, to limits of ± .0005". 18,500 pieces are produced per 8 hour shift.

Grinding Trunnion Bearings on No. 16-A2 Blanchard Surface Grinder.



The BLANCHARD MACHINE COMPANY

64 STATE STREET, CAMBRIDGE, MASS.

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

Not a BUMP *in a BOX FULL*

THAT SPIRABAND of Metalite Cloth sanding off burrs on an airplane engine master rod, is doing it many times as fast as could be done by hand—does endless other jobs equally well.

Of spirally wound abrasive cloth with plain cloth liner, it is made *without a joint;* hence NO BUMP as it quickly smoothes rough surfaces or raw edges.

Other ready-to-use "Gadgets"—Spirapoints, Pencils and Edge-slotted Discs—on your portable tools will finish difficult places inaccessible to other means; do them in seconds instead of the minutes required by hand or other old-time methods.

Make all your high-speed tools *better* tools with these reliable, ready-to-use, fast cutting, smooth finishing, resilient abrasive cloth specialties. Available in hundreds of shapes, sizes and grits.

Ask your friendly distributor's salesman for Metalite Cloth Gadgets or write us at Troy or our nearest branch for the services of one of our field engineers. He'll even demonstrate them *on your own work.*

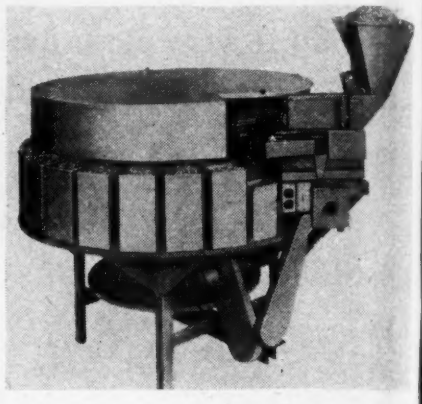
Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, St. Louis, San Francisco, Tacoma

BEHR-MANNING · TROY, N.Y.
(DIVISION OF NORTON COMPANY)
RELIABLE COATED ABRASIVES SINCE 1872

milling cutters to .0005 in. maker, **Detroit Stamping Co.**, Detroit, is stocking this model in all standard arbor sizes.—AVIATION, *Dec.*, '43.

Fastener Sorter 105

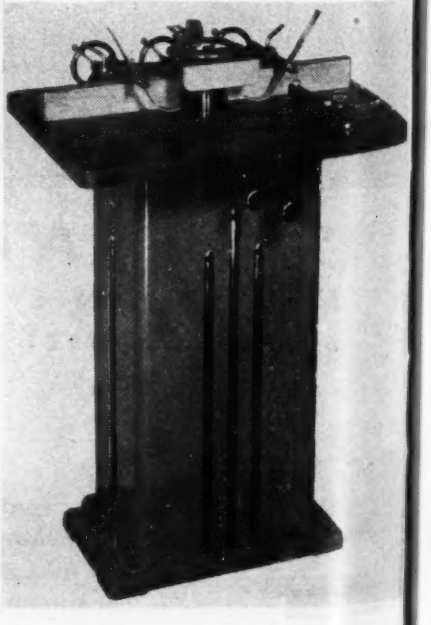
Twenty-four different length screws, bolts, and rivets can be sorted simultaneously on this machine which delivers from 80,000 to 100,000 in 8 hr. into receptacles. Frame is constructed of galvanized steel finished in gray crackle.



Quarter horsepower motor, for 110 V. a.c. or d.c. power, is attached to friction drive. Sorter, manufactured by **Tubin Engineering & Mfg. Co.**, Los Angeles, occupies floor space 5 ft. sq. It is 48 in. high and shipping weight is 1,200 lb.—AVIATION, *Dec.*, '43.

Spindle Shaper 106

Two different diameter cutter arbors formed on a single piece of vanadium steel are featured in spindle shapers offered by **Boice-Crane Co.**, Toledo. Change from one arbor to other is made by inverting quill. Cutters, which run below work thus permitting material of any thickness to be finished, can be accommodated up to 6¼-in. dia. Diameter



The laziest bird on earth!

ONE UNSPEAKABLE MEMBER of the bird family is too lazy to dig for his own food! He rides on the backs of cows, and waits for them to move through the grass. As they do, they stir up insects for him.

But that's not why cowbirds are hated so. They're too lazy to raise their own young! Mother cowbird just drops her eggs in another bird's nest. Since the young cowbird usually pushes out all the other young, every cowbird is reared at the expense of the lives of at least two other birds!

Only one bird has ever outsmarted the cowbird. That bird is the Yellow Warbler. She just builds a new bottom for her nest—right above the egg of the cowbird!

Americans should have a feeling of kinship for the Yellow Warbler, because this ability to get things done by outsmarting the enemy, by bold, sweeping measures, has made American industry famous. It's the same reason so many of our war plants today are using Cone Multiple Spindle Automatic Lathes to get things done. For example, on one job, an 1¼" Six Spindle Conomatic in 10 seconds per piece completes 11 operations, one of which comprises simultaneous threading and tapping in the same spindle position.

A host of new industrial uses is being developed for Cone Multiple Spindle Automatic Lathes as a result of wartime demands. And after victory is won, these new uses for Cone Automatics will contribute in building the kind of world we've all been dreaming about.

ONE Automatic Machine Company, Inc., Windsor, Vermont

PERFORMANCE CONTROLS THE AIR

Cessna Bobcat, Twin-engined Trainer

PESCO engine-driven fuel pump, standard on many planes.

ARMY E NAVY

World's largest educational institution today is the AAF Training Command. In centers throughout the country, hundreds of thousands of the world's finest pilots, ground and air combat crew technicians are trained for action. A tribute to the efficiency of the Training Command, and to the craftsmanship of the workers who build the training planes, is the safety record of the AAF, unequalled in point of flying hours. PESCO Products Co., 11610 Euclid Avenue, Cleveland 6, Ohio. (Division Borg-Warner)

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories...

PERFORMANCE POINTS TO *Pesco* FIRST

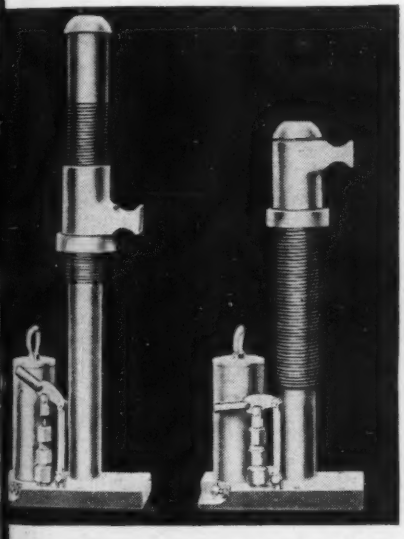
gap around cutter can be adjusted at 3½, and 2 in.—AVIATION, *Dec.*, '43.

ipping Paper 107

Developed to meet specifications for ase-proof, non-corrosive paper for erseas shipment of parts, wrapping terial offered by **Criterion Paper & ine Co.**, New York City, is known as 08-C-17. Stocked in various sizes, it be heat-sealed into bags.—AVIATION, ., '43.

ydraulic Jack 108

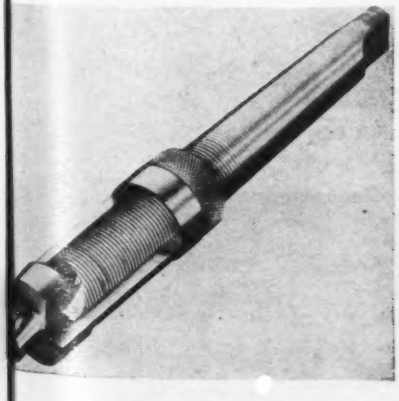
Photo shows hydraulic jack in two posi-ns. Left: Maximum height with raded axle unit allowing nut to adjust at desired level. Right: Axle toe erted at maximum height of 13½ in. shown is minimum height when toe at 5½-in. level and tail unit at 21¼ in.



ile jack has capacity of 5 tons, toe l take 7½ tons on lift of not over 7 in., ording to manufacturer, **Malabar chine Co.**, Los Angeles.—AVIATION, ., '43.

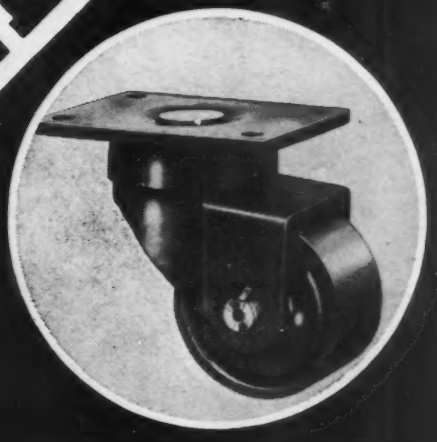
cer, Counterborer 109

Cutter that quickly can be removed re-sharpening is feature of new t facer and counterboring tool. When der is replaced it is automatically dered, since body web locates cutter gers. **J. M. Nash Co.**, Milwaukee.—IATION, *Dec.*, '43.



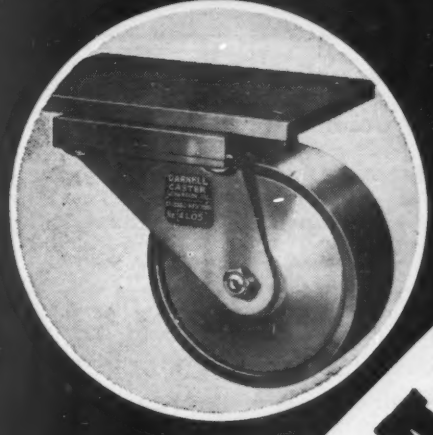
A SAVING AT EVERY TURN

DARNELL CASTERS



Darnell Dependability assures savings, service, safety, speed. A caster or wheel for every use.

DARNELL CORP. LTD., 60 WALKER ST., NEW YORK, N.Y.
LONG BEACH, CALIFORNIA, 36 N. CLINTON, CHICAGO, ILL.



FREE Manual

Today's military personnel transports, so important in the rapid transfer of key personnel from one area to another, are adaptations of well known commercial planes. Many are finished in Berryloid. The peacetime models of these famous planes will also be finished in Berryloid. For more than a quarter century, no other finish has offered such durability and beauty.

BERRY BROTHERS, INC.

DETROIT 7, MICHIGAN • WALKERVILLE, ONTARIO

BOSTON • JERSEY CITY • CINCINNATI • CHICAGO • ST. LOUIS • INGLEWOOD, CALIF.

MONTREAL • WINNIPEG • TORONTO

ARMY E NAVY

BERRYLOID

AIRCRAFT FINISHES

SIDE SLIPS

THERE'VE BEEN some good overload stories lately, but here's a stopper. A 65 hp. *Aeronca*—a job weighing 809 lb. empty—not only got off the ground with a gross weight of 2,375 lb. but it also got to a respectable altitude. The useful load was equal to nine—count 'em—nine 174 lb. passengers.

• A new mid-west plant delivered its first plane the other day, a big cargo job. The craft went immediately to the West Coast where it stayed two days. Just three days later it showed up in Australia. So happy to see you very soon, Tojo.

• Two pilots sent back to this country after serving their tour of duty with a heavy bomber squadron were given a look-see at some of the new armament that will soon be in action. Both men were left slightly goggle-eyed, and one was moved to say, "Boy, I'm glad I'm out of this war before the really heavy shooting starts!"

• Ran across a manufacturer's service representative who gets around a lot and who's got a good idea. He's constantly visiting about a dozen different installations, each of which requires its own identification badge with, of course, rogue's gallery photo. Anyhow, this "rep" says he's going to have them all mounted on one board which he'll just hang on his coat, walk up to any guard and say, "Take your pick, bud."

• A young American was looking at a captured Italian Macchi 202 which had painted on its fin two crude silhouettes of American fighters. Lad studied them a while, then walked away asking, "Are those supposed to be two ships he shot down, two he shot up on the ground, or two he got away from?"

• A manufacturer building one of our newer and more complicated fighters got quite a jolt as he finished taking some reporters—including one completely non-technical gent—through his plant. Starting with the smallest subassembly, he gave them the works, finally ending up in the flight hangar where the normal heavy complement of .50 cal. guns was visible. Chirped the non-technical gent, "Sure go to a hell of a lot of work just to lug a few little guns around, don't you."

• The charming ladies who've taken on so many airline jobs have done a swell job, but occasionally they come very, very close to driving their supervisors completely wacky One of the lovelies, for instance, recently missed a most important traffic meeting. Next morning her harassed supervisor asked how come. "Had a date," was her calm reply. "And with men as scarce as they are, a gal who wants to get married finds any date a lot more important than a dull old meeting."

• Like new taxation schemes, postwar plans come from the strangest places. Take, for example, the one sent in to Carl Friedlander, president of Aeronca Aircraft Corp. It came from Lt. George Haller, waiting out the war in a German prison camp, who wrote that "arrangements have been completed for the handling of *Aeronca* sales in South Africa after the war." Detailing his plans, Lt. Haller asked Friedlander to "kindly write to me confirming the extension of our agreement, covering *Aeronca* sales for a minimum period of twelve months from the cessation of hostilities. We would like you also to arrange for our company to get two of the first *Aeroncas* available for export after the war, as the first company in South Africa to receive new demonstrators will have a big advantage." Unlike new tax schemes, though, you simply can't whip a guy like that.

• Every time we hear these visionary forecasts of at least one helicopter in every back yard, we shudder to think what the third dimension traffic will look like. How'd you like to be in the same sky with a lot of people now allowed to drive automobiles? Called to mind is the remark attributed to Casey Jones who, when asked if the airplane could ever be made safe, replied: "The engineers can make 'em foolproof, but they can never make 'em damfool proof."

"Mr. Maguire is figuring that this may be the last Christmas he'll be sending presents to Hitler!"

For forty years, designers of military aircraft have sought to endow our fighting airmen with higher and higher speeds.

Today the Corsair pilot, with his 2,000 horsepower, commands a blazing speed unmatched in naval fighting aircraft.

CHANCE VOUGHT AIRCRAFT

STRATFORD, CONNECTICUT

ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York

Allied Superiority Increases in All Theatres; 15th Air Force Activated in Mediterranean

RAF and AAF are now putting up more than 1,000 planes each in concerted attacks. Thus Germany is being hit by more than 2,000 on some occasions. This force will increase rapidly. American fighter strength will be doubled numerically by the new year and its range will permit escort of bombers deeper into enemy land.

In reply, the Nazis are building fighter strength, multiplying anti-aircraft defenses, and burning night oil trying to develop miracle weapons like the rocket bomb, the fire disk, and the electronically guided glider bomb.

Allied shuttle operations between England and Mediterranean bases are giving missions two chances of finding weather suitable for landing instead of one. Italian and African weather will enhance all-winter attack, and the northward advance in Italy brings more enemy objectives within the short range that makes heavy bomb loads possible.

Lt. Gen. Carl A. Spaatz was placed in command of American Mediterranean flyers as the new Fifteenth Air Force was activated to carry the attack from the South. Spaatz immediately sent the 15th on a long-range blow at a Messerschmitt works in Austria. AAF, however, has still to confirm his appointment as an official command.

Some responsible officers still say they cannot detect any curtailment of German power as a result of Allied bombing; others say the Reich is being badly hurt, and that the benefit accrues mostly to the Russians, contributing greatly to their successes.

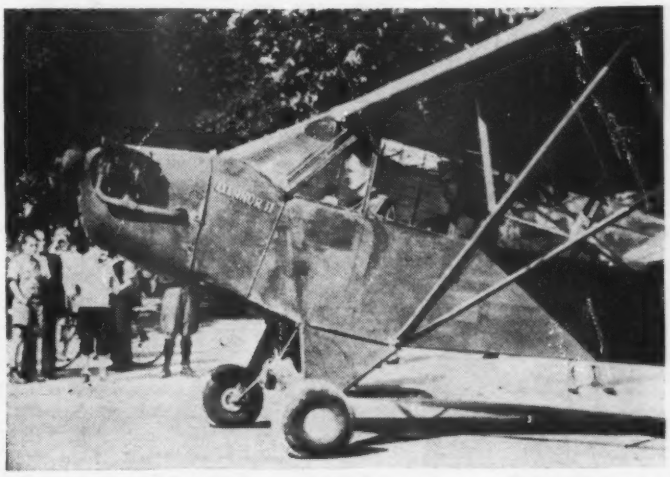
The Allies have complete command of the air over Italy, but over strong points in Germany the *Luftwaffe* has equality and takes heavy toll. However, average Allied losses are 5 percent, which Britain and the United States can well afford. Except for sporadic raids, Germany seems to have been knocked practically out of the air over England; Hitler is taking 106 tons of explosives for each one he lays on the British.

Goering has replied to RAF *Mosquito* torment with a Messerschmitt 410 two-engine fighter-attack plane. British AA gunners bagged one recently. RAF men looked it over and think they can meet it all right.

In the Pacific, American and British sea and air power has driven the Jap Navy partially to cover. Combined U. S. and British carrier forces are approaching such formidability that they must be considered one of the major "bases" from which the Jap empire can be hit. Great store is set by the new B-29 for this purpose, too, though it is too big to operate from any carrier yet contemplated. But some sources say the Allies have land bases now from which it can operate. If not, they say our sea forces can take the bases when the B-29's are ready.

The Japs are following Germany's strategy. They have cut back on bombers and are concentrating on fighters, a tell-tale defensive move. Their numerical aircraft production rate is thus increased, probably to over 1,000 per month.

The Navy's *Hellcats* and *Corsairs* are reported better than anything the Japs have or can build. Fire power on Navy fighters is five times what it was in 1940. Armor, range, and the ammunition charges have been increased while the planes have surpassed the Jap's in rate of climb and in ability to turn. Incidentally, there are a hundred times as many aerial shooting irons on war ships as there were three years ago.



"CUB" CARRIES CLARK

Lt. Gen. Mark W. Clark (seated behind pilot) hops around Italy directing his 5th Army in Piper Cub dubbed "Eleanor II." Here he is taxied along a Naples street. On another occasion, he landed on a ball field—and got in the soldiers' game. (Acme photo.)

"Air Superiority . . . First Requirement"

Washington (AVIATION Bureau)—Without publicity and attracting little attention, the Army has issued field regulations which appear to take the AAF another step toward the independence long sought by many of its partisans.

The regulation, printed last July and not yet fully disclosed, says "land power and air power are coequal and interdependent forces; neither is an auxiliary of the other." Secretary of War Stimson caused the regulation to be issued, and it was signed by Gen. George C. Marshall, chief of staff.

"The gaining of air superiority is the first requirement for success of any major land operation," the order says. ". . . Air forces must be employed primarily against the enemy's air forces until air superiority is obtained. In this way only can destructive and demoralizing air attacks against land forces be minimized and the inherent mobility of modern land and air forces be exploited to the fullest."

Theater commanders are instructed to exercise command equally through air force commanders and through ground force commanders. Gen. Dwight D. Eisenhower's command, for example, is handled in this manner.

40th Anniversary

As Dec. 17th again approached, Gov. J. Melville Broughton of North Carolina issued a proclamation calling upon the Army, Navy, government agencies, and the industry to send representatives to Kitty Hawk for an observance of the 40th anniversary of heavier-than-air flight and as a tribute to the memory of Wilbur Wright and to his brother Orville, just turned 72.

Medical Agency Urged

Dr. W. R. Stovall, medical director of CAA, thinks that a central agency should be established to make wider practical use of theoretical knowledge of pilot qualifications gathered by military and private aviation.

Since 1926 we have depended solely upon CAA medical examiners and general medical knowledge in determining whether an applicant with certain physical or medical deficiencies should be allowed to fly. The only concern of CAA is whether a pilot can fly with safety to himself and others, in contrast to the military selection of the best flyers available. Despite this difference, civil aviation medicine has been patterned along the lines of the military.

Baruch Appointed Surplus Administrator; Congress Debates Disposal Policy

Washington (AVIATION Bureau)—While Congress debates methods of disposing of surplus government war equipment—which may reach a total value of 75 billion dollars—the administration has made its first definite move to resolve the conversion - termination problem with the appointment of Bernard M. Baruch, chairman of the last world conflict's War Industries Board, to tackle the job.

Baruch will direct a new unit within James F. Byrnes' Office of War Mobilization, which announced that his duties would be "to deal with war and postwar adjustment problems and to develop unified programs and policies to be pursued by the various government agencies concerned." He will also be concerned with adjustments necessitated by "the changing requirements of our war strategy."

In aviation alone, the magnitude of Baruch's new task is staggering. While warplanes generally have no commercial value and the peacetime usefulness of military cargo and troop planes is still being debated, there are vast quantities of engines, propellers—300,000 to 500,000 will have been delivered if the war lasts another year—instruments, and other parts suitable for civilian modification which could glut the postwar market unless some systematic scheme is evolved for disposing of them.

Both Army and Navy are terminating many contracts now—the total is approaching 10,000, but Comptroller General Lindsay C. Warren, who heads the General Accounting Office, says that no one except it has authority to settle claims against the government. Indications at this writing were that final settlements, negotiated by Army and Navy will have to be approved by GAO under law which Congress is now drafting.

Sen. James E. Murray and Rep. Wright Patman have introduced a bill (HR 3580) to have all war surpluses liquidated by a custodian under the direction of a special Senate-House Committee. After hearings, the House Small Business Committee has concluded that one central agency should be created rather than multiple ones for various industries.

No matter what the eventual agency is, it will probably be instructed to operate under policies decided by Congress or the President. It is not yet clear whether the legislators or the executive will wield the control.

There is considerable opposition to Rep. Clarence Lea's bill providing for CAB to dispose of warplanes. The board's chairman, L. Welch Pogue, and vice-chairman, Edward P. Warner, have both expressed the opinion that CAB should not be asked to take sole responsibility for such liquidation. Pogue recommended a new corporation, on whose board of directors would sit representatives of Army and Navy and the State, Treasury, and Commerce Departments and CAB. The aircraft and air transport industries both would approve of an agency to handle aircraft alone rather than be lumped in with a non-exclusive surplus agency.

Many industries want legislation which will require—not merely permit—federal contracting agencies to make immediate cash settlement for costs and losses on canceled contracts. The aircraft industry wants 90 percent of amounts producers certify are due them, with negotiations to come later. Claims against the government hung fire for 15 and 20 years after the first war. Now everybody wants to get in the clear and started on new war production, or on peace work. Both these courses depend upon clear cut action on contracts.

Navy Carrier Force Bigger, More Coming

Washington (AVIATION Bureau)—Navy now has an aircraft carrier force capable of launching a major air invasion of the Jap empire. During 1944-45-46, that force will be heavily augmented.

We now have almost as many carriers as battleships, plus nearly three-score auxiliary (escort) carriers. Next year, delivery of regular carriers will be almost double. (Few people realize that this country is capable of building from one to two of these vessels per month.) In 1944, scores of auxiliaries will be produced by the Navy and Henry J. Kaiser under the Maritime Commission program. In 1945, two new 45,000-ton carriers will be delivered and a third in 1946.

Fleet carriers base 60, 70, or 80 planes each; auxiliaries 5 to 15. The new super-flat-tops will base two-engine bombers, some larger than the B-25's and will be able to take them back.

Probably they will be able to launch four-engine heavies not to be taken back.

The battleships *Iowa* and *New Jersey* displace 45,000 tons, but the same-weight carriers will have greater dimensions, more speed, more guns, and some armor. (Ordinarily carriers are thin-skinned like merchant ships and destroyers.) They will come nearer to the adequacy of land bases than carriers ever have before.

Many authorities believe the carrier is a one-war weapon and that land-based planes, before many years, will have sufficient range to reach all objectives.

West Coast Manpower Utilization Improves, But Materials Still Exceed Personnel

Washington (AVIATION Bureau)—There probably will never be enough manpower to chew up the materials now available. But the situation has improved, resulting in an upsurge in aircraft production which is approaching a rate of 9,000 per month about now.

WPB Chairman Donald Nelson said the increase was due to fewer design changes and to improved utilization of manpower. A controversy has developed over whether manpower was being efficiently used. West Coast plants found from a study that output had increased 4,260 percent since 1940 while personnel went up only 933 percent. But people in several aircraft producing communities feared that the urgent need for warplanes would cause WPB and the Army to cancel too many contracts in non-aircraft lines, disrupting business—and the unions which controlled labor. Congressmen and war supply officials were given many reports of wasteful use of time.

It was hard to tell who was right, and ground was taken and given by both sides. Selective Service deferred irreplaceable workers for a period of six months, with provision for renewal of deferment. This was done at the instigation of Office of War Mobilization Director James F. Byrnes, who said authority of draft boards was not abrogated. It was a program of planned replacement, he said.

On the other hand, C. E. Wilson, chairman of the Aircraft Production Board of WPB, turned down a request of North American Aviation for 10,000 additional workers on the ground that the 37,000 the company had on hand would be enough if used efficiently. This action seemed to have been urged by the Truman Committee, which had received reports from workers and citizens in the Dallas area.

The Area Production Urgency Plan, effective on the West Coast Oct. 15, is said to be working. It is a broad extension of the program to integrate production needs with manpower resources. It was written by Byrnes' OWM, a branch of the White House, and handed to industry. Whether it has been effective long enough to bear upon the current increase in production is not yet determinable.

SINGLE-PLACE, DOUBLE-ROTOR 'COPTER

Fred Landgraf, aircraft factory engineer and spark of Landgraf Helicopter Co., Los Angeles, inspects experimental helicopter on which he's been working two years. Made of plywood, it has enclosed 90 hp. engine driving rotor through clutch disks and tension rods. Other features: small ailerons on blade tips and retractible tricyle landing gear. (INP.)

Back Copies to Spare?

Readers of this magazine, other McGraw-Hill publications, and other scientific journals who would be willing to donate their back copies to the cause of reconstructing the files of war-torn European libraries are requested to get in touch with Dorothy J. Comins, Library of Congress Annex, Study 251, Washington 25, D. C.

Branch Stores and Banks, Incentive Pay Applied to West Coast Manpower Problem

While it was reported that house-to-house canvassing and an Army-sponsored rally which attracted 40,000 Seattleans to University of Washington Stadium had brought a rush of applicants temporarily swamping Boeing employment offices, the company itself and others on the Coast are still labor-short.

Officially Boeing reported that it had recruited 2,700 workers of a required 9,000 in one recent period of about six weeks. Out-of-state hiring teams had dispatched 800 people to the Seattle area with another 950 promised, according to latest available figures.

"While Boeing's immediate labor shortage in Seattle is now eased considerably," it was said, "continued employment over a long period of time will be required for the longer-range build-up and for replacements of normal turnover." To simplify some of workers' living problems, Pacific National Bank and a Seattle department store have established branches in *Fortress* plants (see cut).

More house-to-house canvassing for employees has been sponsored by the Los Angeles County Board of Supervisors and Northrop, Douglas, Vega, Lockheed, and Consolidated Vultee. Two-thirds of 50,000 16- and 17-yr.-old school boys who spent the summer in Southern California plants are expected to continue work throughout the year under an arrangement with school authorities allowing them to work four and study four hours a day.

Meanwhile, two North American and two Northrop plants went on two ten-hour shifts instead of three eights, and set up worker incentive systems—extra pay for meeting quotas. These are guinea pig operations and are being watched by other producers and by the government. Neither labor nor management likes the incentive system, and the War Production Board has had a hard time selling it.

Boeing of Canada Retools

Vancouver, B. C., No. 2 plant of Boeing Corp. of Canada is being retooled for production of Avro *Ansons*, used as trainers for *Mosquito* pilots. The new Roe model will have considerably more power, approaching that of the de-Havilland.

Orders placed with Boeing of Canada have necessitated subcontract of wing assemblies for Martin *Catalinas* to a Portland, Ore., company and the leasing of the civic arena at Nelson, B. C., where 250 employees, 60 percent of them women, will do subassembly work.

Canadian Notes

By James Montagnes

Toronto is to have a new postwar airport, according to Munitions & Supply Minister C. D. Howe. The field, built for war purposes, is to be developed as a postwar government project to accommodate the largest air transports. Advantages of the port, which is now employed by DeHavilland, is that it is but a short distance from the city, not 17 mi. off as is the present commercial field at Malton. The latter is to become an emergency field, while the RCAF training drome on Toronto Island, will become an auxiliary field and seaplane base.

It's now rumored that the Avro *York*, transport version of the *Lancaster* bomber, will be built at the government-owned Victory Aircraft, Ltd., which now turns out *Lancasters*. The *York* seats 50 persons, is 78 ft. long, has a span of 102 ft., and mounts four *Merlin* engines.

New Montreal-Britain record is reported by TCA—11 hr. 56 min. The run was made by one of the company's converted *Lancaster* transport craft carrying passengers and mail on the new twice-weekly transatlantic war service. (Editor's note: The converted *Lancasters* now used by TCA are not to be confused with the new *York*-version planes. One of the converted bombers was incorrectly termed a *York* in our page 272 caption, Oct. AVIATION.) It is expected that TCA will employ *Yorks* in its postwar transocean runs.

The 1,000th *Cornell* elementary trainer built by Fleet Aircraft, Ltd., was recently presented as a gift to the RCAF by the employees of the plant.

Reports have it that the Canadian government is negotiating with Vancouver city officials for large scale expansion of Vancouver Airport. Civic officials have in mind a long-range development view calling for a combined land and seaplane port to serve Canada's third city.

The RCAF, which by latest official data has 32 squadrons abroad, will eventually have 38 such all-Canadian squadrons in overseas operations. In addition, more than 25 percent of the flying strength of the RAF is made up of RCAF aircrews serving, and the percentage is increasing.

While "trying a coat for size," Boeing worker inspects sweaters offered by Seattle's store's branch maintained in "Fortress" plant as shopping aid for time-short employees.

The Washington Windsock

By BLAINE STUBBLEFIELD

The Stubblefield award is reserved this month for Filene's department store in Boston—in case they obtain CAB helicopter certificate and get tangled up in somebody's revolving clothes line while delivering packages. Incidentally, a 'copter at National Airport the other day blew away all trash and dust. Another postwar use: Street cleaning.

Note on the advance of civilization: Migrating birds are detouring the Russian front where the air is full of fighting airplanes, noise, bullets, shells, fire, smoke, and radio locator waves.

You hear high officials using the same ideas and even the same phrases about postwar international aviation. Some agreement somewhere?

There is no freedom of the air or of anything else unless it is guaranteed by popular will and force if necessary. Same goes for sovereignty. A man who will strongly influence the air future said that.

Admiral Land, chairman of the Maritime Commission, recently said that he is opposed to acquisition of air auxiliary services by steamship operators. Of course the operators and the commission may disagree with him.

More about Ploesti: The B-24's used special time-fused bombs, devised by Ordnance, to escape their own explosions. Planes approached at tree-top level to avoid early detection by radio locators, rose to 200 ft. over the target to miss smokestacks. Bombs were skipped into enemy installations.

Army objected to OWI's second aircraft report (to no avail) on the ground it could serve no purpose. At least two manufacturers protested what was said about them, and at least one got corrections made.

Industrial designer came here to testify at CAB hearings on feeder lines. By mistake he got into Post Office hearings on charges against a magazine for printing snappy girl pictures. Designer was sworn in—then pulled out drawings of a 20-passenger helicopter.

With flexible shaft, with stationary set-up, or by hand
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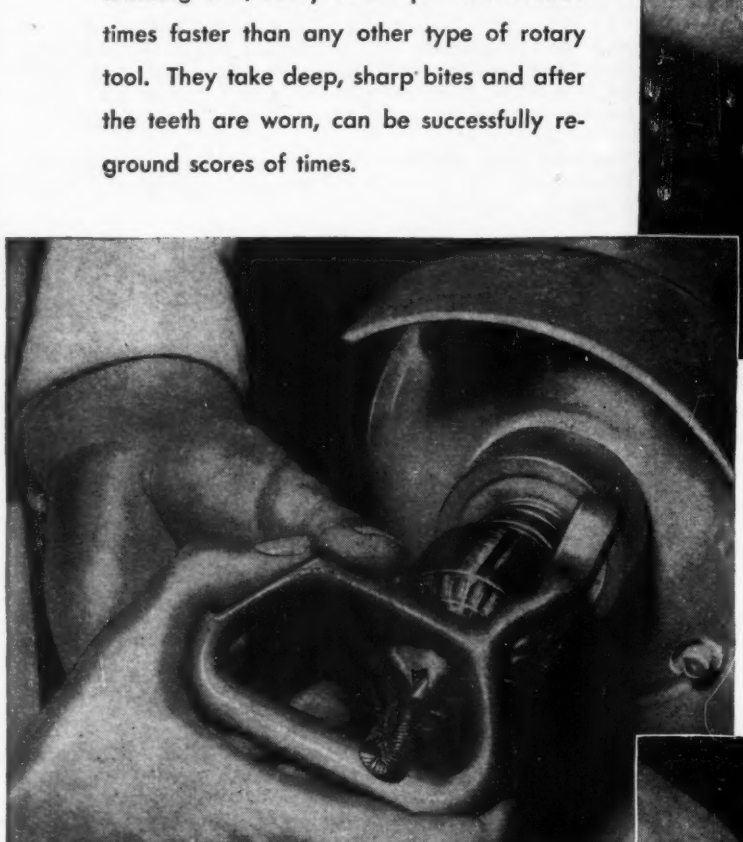
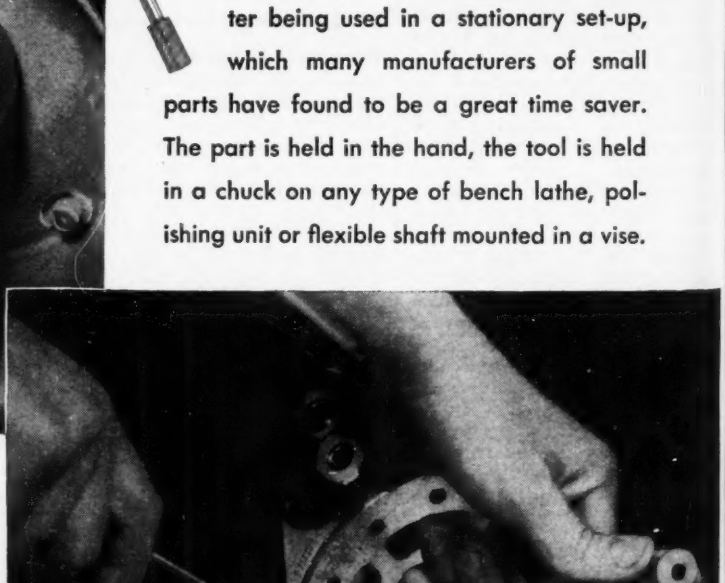
Because of their hardness, design and keen cutting edges, Severance Midget Milling Cutters speed up finishing time, easily do the job two to three times faster than any other type of rotary tool. They take deep, sharp bites and after the teeth are worn, can be successfully re-ground scores of times.



Left: A Severance Midget Milling Cutter being used in a stationary set-up, which many manufacturers of small parts have found to be a great time saver. The part is held in the hand, the tool is held in a chuck on any type of bench lathe, polishing unit or flexible shaft mounted in a vise.

Right: One of the Severance Hand Deburring tools. With a twist of the wrist this Cutter easily bites off the burr or sharp edge left by a drill or punch. Available in a wide range of sizes with radius, ball nose or angle. Write for complete facts on how Severance Midget Milling Cutters can help you speed up your cleaning and finishing operations.

Severance complete line of "Carbide" Midget Milling Cutters are now available.



Severance

SEVERANCE TOOL INDUSTRIES INC., SAGINAW, MICHIGAN. PLANTS IN LONG ISLAND CITY, NEW YORK; DETROIT, MICHIGAN; FORT WAYNE, INDIANA; CHICAGO, ILLINOIS; LOS ANGELES, CALIFORNIA.

CALLING NAMES ★

Tyrrell Krum has been named director of public relations for Reynolds Metals Co. with headquarters in Washington.

Courtlandt S. Gross, president of Vega, was recently appointed vice-president and general manager of Lockheed; **Mort Bach,** works manager of Vega since 1941, also returns to Lockheed as works manager, relieving **John H. Sreenan** from that post in order that he may devote full time toward branch plant production problems. **F. Penn Holter** will assist Bach as asst. works manager; **Jack Cartwright** remains night asst. works manager; **Harvey C. Christen,** another Lockheed veteran, is assigned to a staff capacity representing the works manager's office; **George H. Prudden** succeeds Bach as works manager at Vega and is in turn succeeded by **W. G. Dollmeyer.** Another transfer from Vega was the recent appointment of **Harris McIntosh** as special assistant to **Pres. Robert E. Gross.**

Stewardess Helen Thorne succeeds **Laurabelle Godlove** as instructor of stewardesses for United Air Lines. Miss Godlove returns to active flight duty on UAL's Pacific coast route.

Paul R. Jordan, general manager of Harvill Corp., was elected v.-p. and gen. mgr. at a meeting of the board of directors.

H. Delaney Dilworth joins United Air Lines at Chicago as rate and tariff analyst.

Woodrow Campbell is appointed supervisor of the restaurants and food service for Western Air Lines.

William I. Selover, manager of Sperry's Los Angeles district office, is sporting a diamond studded gold pin in his lapel signalizing 30 yr. with the company. **Pres. R. E. Gillmor** presented the pin at a dinner honoring Mr. Selover.

Richard Brown, chairman of the board of Brown Instrument and v.p. of Minneapolis-Honeywell, has been named deputy director of WPB, 3rd region.

Dorothy M. J. Tracey, v.-p. of Tompkins-Johnson Co., has been appointed general manager, succeeding **Pres. A. R. Johnson** in this capacity.

J. H. Tudhope, former RCAF squadron leader, is appointed executive assistant to **Pres. H. J. Symington** and **V.-P. O. T. Larson** of Trans-Canada Air Lines, with headquarters in Montreal.

Paul Heineck is appointed midwest hydraulics representative of Bendix Aviation, Ltd.

John W. Cross is appointed general counsel of Mid-Continent Airlines.

Frank P. Tighe is appointed director of public relations and advertising for the Houdry Process Corp.

C. Bedell Monro, PCA president, will lecture on air transportation to graduates and advanced undergraduates of the American University School of Social Sciences and Public Affairs during the fall semester.

TWA announces the following promotions: **J. Reay Jones** is appointed asst. to **Traffic v.-p. Conroy; Lee Swigert,** district traffic manager in the N. Y. area, has been promoted to eastern regional traffic manager, succeeding **William F. McGrath,** recently named system traffic supt. at K. C. **A. D. "Don" Williams, Jr.,** is named new N. Y. district traffic manager; **Clyde S. Fullerton** is sales manager; **Louis P. Marechal** succeeds Fullerton as director of traffic training; **Vernon Y. Gunn** is promoted to the newly created post of asst. to the central region manager, **L. A. McDonald** succeeds him as district traffic manager at Dayton; **Ed B. Johnson** as asst. to the regional manager of the recently created mid-west div., with headquarters in K. C.; **Clancy W. Dayhoff** is appointed asst. to **Arthur Stewart,** western region mgr.; **Robert B. Riordan** becomes supervisor on the K. C. traffic training staff, and **Joseph F. O'Keefe** succeeds him; **Norvel Waldron** is asst. to the K. C. traffic training director; **Frank P. McGough** moves up to reservations supervisor, with K. C. as headquarters; **Parks E. Gilmore** becomes Chicago reservations manager; **Dale Y. Ecton** becomes K. C. guide dept. manager, and **George Brown, Jr.,** moves up to post of market research project representative.

Edward J. Eidson is appointed assistant to the general traffic manager of American Airlines.

Wm. Martin Grampp, formerly director of purchases for Brewster Aeronautical, joins Black Bear Co. as general manager.

Jerry Bacon, RFC Ace in World War I, is flight instructor for Southwest Airways teaching RAF and USAAF cadets.

H. Hauflaire is appointed to the recently created position of director of industrial relations; **Charles Young** succeeds him as personnel director, and **Charles Crowther** is the new plant supt. of Aerco Corp.

J. H. Spade is named asst. treasurer at Sikorsky Aircraft. Gardenville Airport near Buffalo offers a free course in flying to the finder of **"Duke"** their unofficial guard. Duke was the custodian of the hangars and the self-appointed guardian of the planes.

Henry S. Jones assumes duties as factory manager of Fairchild's Burlington plant, succeeding **Clayton Merry.**

Luther H. Atkinson is appointed v.-p. in charge of sales of Elastic Stop Nut Corp.

Mrs. Mary Jackson, organizer of women's counseling service at Consolidated Vultee's San Diego plant, is named asst. to the director of industrial relations and will extend the service to other Convair plants. **Miss Thelma Swank,** newly appointed chief counselor, will assist Mrs. Jackson in the organization of a counselor training course.

Alan G. Day is new representative of Hamilton Standard Propellers at Wright Field.

William V. Brown is appointed asst. director of postwar planning for Northeast Airlines. **John T. Griffin** is named operations manager for both Atlantic and commercial divisions; **Howard D. Ingalls** is named v.-p. in charge of engineering and maintenance, and **John A. Reece** is named director of pilot training division.

Walter W. Fowler, operations supt. of Trans-Canada Air Lines, is named asst. operations manager at Winnipeg, and **Frank I. Young,** at present Toronto chief pilot, succeeds him at Moncton. **William J. Lawson,** former Texas secretary of state, is appointed special representative for Braniff Airways.

★ ★ ★

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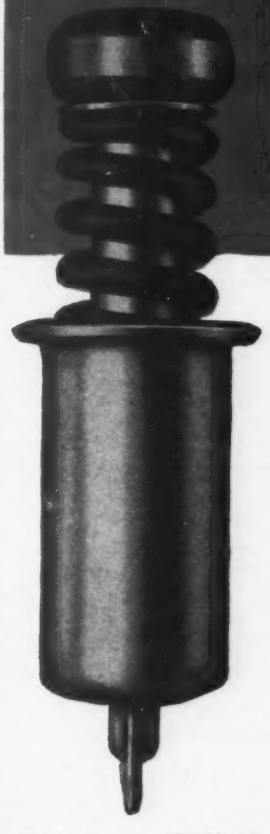

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. . . A SCOVILL PRODUCT

Hush on B-29 Partially Lifted

"We now have a third superbomber . . ." said Gen. H. H. Arnold, chief of the Army Air Forces, for the first time publicly mentioning the B-29. The plane, he revealed, was "developed by the Boeing Aircraft Co. in close cooperation with the AAF and its Materiel Command and evolved in secrecy during the past several years.

"The engineering of the B-29 design was accomplished by the large Boeing staff at Seattle, which originated and developed the B-17 *Flying Fortress*. First experimental models were built at Seattle.

"Engineering and production information has been turned over to other major aircraft manufacturers who also will produce the plane through final assembly and to other industrial concerns which will handle subassembly or parts production."

This War Department statement, quoting Gen. Arnold, gave no more specific information, but it is known that initially two Boeing plants, one bomber plant, and another built specially for this plane, will turn out B-29's. Concerns making subassemblies include at least one leading automotive producer.

Gen Arnold said that the B-29 is as far ahead of the B-17 and the B-24 as they are out in front of prewar bombers. He emphasized, however, that production of the B-17 and the B-24 is being steadily increased.

Performance of the new bomber cannot be discussed before it enters combat (sometime in the spring, according to the OWI). The AAF chief said that it has a range "substantially greater" than the maximum effective range of today's longest-range heavy bombers, and it will carry quite a sizeable bomb load for that distance. "When it enters combat," he said, "today's long range will become medium range and today's heavy bombers will consequently become light heavies."

Competent sources said the B-29 is wanted in the attack on Germany to carry heavy loads of bombs to munitions works in eastern Germany and those that have been moved into Austria, Czechoslovakia, and Poland.

Gen. Arnold previously had said the new heavy bomber would be able to attack Europe from U. S. shores. He did not say with what percentage of load. The model now in production is not the same as the original design.

When there are enough B-29's, they will doubtless attack Japan from points now in Allied hands or which can be taken with rapidly increasing Naval, Army, and air strength.

MISSION FROM CHILE

Chile has more pilots than planes, so extra craft from this country would help augment her participation in hemisphere defense, according to Lt. Gen. Manuel Tovarias Arroyo. Arriving in this country by PAA "Clipper" for a tour of U. S. and Canadian bases and plants, he is greeted by Lt. Col. E. J. Hall. In background (left) are Alfred Canel, office of Coordinator of Inter-American Affairs, and Capt. Javier Undurraga Vergara, the general's aide. At a press conference, general revealed that Chile is watching Strait of Magellan for Jap blockade runners. (International News photo.)

★ SPOT CHECKING ★

The National Clinic of Domestic Aviation Planning was convening in Oklahoma City at press time. Scheduled speakers: Col. E. S. Gorrell, Casey Jones, Igor Sikorsky, Eddie Rickenbacker and Mayor LaGuardia.

Aeronautical Chamber of Commerce has approved "in principle" recommendations submitted by its Economic Development Committee following the latter's recent Colorado Springs meeting. Twenty-nine specific suggestions were prepared on contract termination, contract renegotiation, export, and use and disposition of surplus government-owned aircraft and defense plants and equipment (p. 118 and 262, Nov. Aviation).

Nation's first successful helicopter, Sikorsky's VS-300, has been presented to Henry Ford's Edison Institute, Dearborn, Mich.

Production of 100 octane gasoline, now four times that of early 1942, will be doubled again in the next few months, OWI discloses. Units, employing new or improved cracking processes have recently been put in operation by Gulf and Socony-Vacuum. Atlantic is building two more large units.

Roy A. Watkins, executive vice-president of Howard Aircraft Corp., believes the work of women in aircraft so satisfactory that they will hold their jobs after the war despite expected pressure to fill their places with men.

Low pressures at altitudes above 30,000 ft. can disturb brain gray matter and produce blindness on one side of a pilot's vision, it has been reported to Aero Medical Assn. The symptom disappears on landing.

Opening in Alabama of new bauxite (aluminum ore) mines is reported by the Bureau of Mines. Coincident, however, was a WPB announcement of cutbacks in the bauxite production program in order to save labor.

Reported is award of a subcontract to Hayes Mfg. Corp. for Bell plane wing and tail subassemblies.

The Cub Flier's Club, sponsored by Piper to teach its employees to fly, now has 107 women in its total membership of 276. Twenty-two of the 300 stars in the Club's service flag are for former girl workers now in the WASP.

★ MILITARY MEMOS ★

The Mediterranean campaign was a year old early last month, and when Allied air forces assessed damage inflicted they counted 6,000 enemy planes destroyed, half of them on the ground.

Over the past four months, RAF has dropped an average of 16,000 tons of bombs a month on Nazi territory, the U. S. 8th 5,000 tons.

Remington Arms Co. announces development of new incendiary .50 cal. ammunition called "hot enough to ignite self-sealing gas tanks."

Seventy percent of crews shot into the sea in one theater have been picked up by AAF's new Emergency Rescue Branch.

Wounded are being evacuated on litters designed to fit in bomb bays of *Fortresses* and *Liberators.*

Lt. Gen. Ira C. Eaker, commander of the 8th, has been made a Knight of the British Empire by King George. Like all U. S. citizens he is forbidden to accept the accolade of knighthood and the title "Sir" by the U. S Constitution.

Maj. Gen. Clayton L. Bissell is new assistant chief of air staff for intelligence, succeeding Brig. Gen. E. P. Sorenson. Gen. Bissell is former commander of 10th Air Force (India).

While Jap air power in the northern Solomons seems to have been liquidated, Maj. Gen. George V. Strong, chief of intelligence, general staff, warns, "The Japanese are in a strong position today and their power in many respects is steadily increasing."

Navy's prewar flying personnel of 1,200 has grown to 29,000 and will be more than double that figure in the next year, says Under Secretary Forrestal.

Locations and Commanders of Army Air Forces

1st —Mitchell Field, N. Y.; Brig. Gen. Frank O'D. Hunter
2nd—Colorado Springs; Maj. Gen. S. T. Clair Streett
3rd —Tampa, Fla.; Brig. Gen. Westside T. Larson
4th —San Francisco; Maj. Gen. Wm. E. Lynd
5th —Australia; Lt. Gen. George C. Kenney
6th —Canal Zone; Maj. Gen. Hubert R. Harmon
7th —Hawaii; Maj. Gen. Willis H. Hale
8th —England; Lt. Gen. Ira C. Eaker
9th —Middle East; Maj. Gen. Ralph Royce
10th —India; Brig. Gen. Howard C. Davidson
11th —Alaska; Maj. Gen. Davenport Johnson
12th —(Disbanded)
13th —South Pacific; Maj. Gen. Nathan F. Twining
14th —China; Maj. Gen. Claire L. Chennault
15th —Mediterranean (Commander not yet announced)
China-Burma-India Air Force, India; Maj. Gen. Geo. E. Stratemeyer

OBITUARY

Graham Bethune Grosvenor, 59, member of the executive committee and board of directors and special assistant to the president of Pan American Airways; former president of Aviation Corp. and Fairchild Airplane Mfg. Corp. and former vice-president of Fairchild Aviation Corp. and Otis Elevator Co. of Texas.

David Beecroft, 68, onetime assistant secretary and director of Bendix Aviation Corp., which he joined in 1928 when it was known as Bendix Corp.; treasurer and past president of SAE.

Caleb S. Bragg, 56, test pilot and altitude flyer during last war and shortly thereafter, in 1916 co-organizer of Wright-Martin Co., later inventor (with V. W. Kliesrath) of booster vacuum brake bearing their names, subsequently president of Langley Aviation Corp. and vice-president and consulting engineer to C. M. Keys Aircraft Service, a position he resigned last spring.

Record 8,362 Planes Made in October Includes New High in Heavy Bombers

After months of striving against obstacles, chiefly the manpower shortage and design changes, the industry made a 10 percent production gain of 764 planes in October. The total for the month was 8,362.

Donald Nelson, WPB chairman, just returned from a trip to war fronts, made the announcement and expressed the satisfaction of military and civilian leaders.

The new production record included a new high in heavy bombers for any month. October slightly exceeds a rate of 100,000 planes a year and represents the best month-to-month gain since an increase of 10 percent was recorded last May.

Nelson said the rise was due chiefly to increased labor productivity and to a reduction in the number of design changes on some models which have gone "over the hump" in that regard. The average monthly airframe weight output per employee now is about 60 lb. compared with 28 in Jan., 1941.

"We are going to produce more and more *Fortresses* and *Liberators*," Nelson said, "as well as large numbers of super-bombers," i.e., the B-29.

An unknown number of B-29's was included in the October count. Increasing emphasis on the now "light-heavy" B-17's and B-24's and on the heavy B-29's will cause numerical output to mean even less in estimating effective air power than in the past. Nevertheless, the President's suggestion that for accuracy aircraft production be reported in pounds is still not followed. A production official recently revealed that the average weight of warplanes has increased 50 percent during the past three years and will increase another 50 percent in a shorter time.

October numerical production compares with 7,598 in September, 7,612 in August, 7,373 in July, 7,094 in June, and 7,087 in May. Some authorities believe the rate can reach 10,000 per month by the new year, but many disagree.

There is no official mention of the Byrnes manpower directive which was made effective on the West Coast Oct. 15. It is believed that it could not have had much influence on production at the time of this writing.

Navy announces that its recent production emphasis has also been on bombers. Torpedo plane production in the first half of 1943, it is said, "was larger than during the preceding 30 months of the defense program combined. Production of dive and patrol bombers in the first six months of this year approximates total production in the preceding two-and-one-half years."

Distributors Plan Clinic

Plans for a service clinic to be held in collaboration with the National Aviation Training Assn. were discussed at a recent New York gathering of the Aviation Distributors and Manufacturers Assn. The latter is holding its first annual meeting at the Hotel Jefferson, St. Louis, Dec. 1st, 2nd, and 3rd simultaneously with the NATA convention in the same city.

In the preliminary New York gathering, some 35 manufacturers and distributors also considered tentative drafts for their proposed St. Louis program. Accomplishments, future plans, and relations with NATA were also discussed.

Officers of ADMA are Ray Snyder, president; W. F. Scott, Jr., vice-president; and George A. Fernley, secretary.

Brewster In Recoup; Contracts Changed

After weeks of disturbing headlines and a House Naval Affairs Committee investigation of its management and labor and the Navy, to which its three plants are assigned, Brewster Aeronautical Corp. has settled down to an attempt to recoup its production, which had slumped badly, according to several official charges.

Henry J. Kaiser, noted shipbuilder, recently assumed the Brewster presidency, succeeding Frederick Riebel Jr., who last spring succeeded C. A. Van Dusen. Riebel had made a good record as trouble shooter for the Navy and has gone back to that work. Company has a new contract with the CIO automobile workers union; it has been entered on the records of the Naval Affairs Committee. Differences between management and labor seem to have been patched up.

The company's SB2A shipboard dive-bomber (and its British *Bermuda* version) are to be tapered off to cancellation as of the first of the year to devote full capacity to the Vought-designed F3A *Corsair*. Twelve of them were delivered, Kaiser announces, between the first and sixth of November. "We have only just begun," he says, promising "real production" by the first of the year.

During October, he reports, his Vancouver shipyards built four aircraft carriers.

'Copter Laboratory Asked

A laboratory to develop the aerodynamics of the helicopter will be constructed at Langley Field, Va., by the NACA if funds requested are authorized by Congress.

The first supplementary appropriations bill for fiscal 1944 contains an item of $1,161,500 for an NACA lab for work on wing flutter, vibration, compressibility, and helicopters.

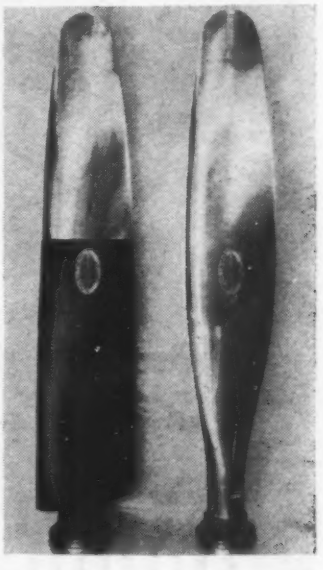
NACA, in its testimony, stated that the helicopter is being successfully flown without complete knowledge of rotor operation. More information will have to be gathered before large helicopters can be perfected, officials say.

Phenomena of flutter and compressibility at speeds above 400 mph. will be studied in the proposed lab at the urgent request of the armed forces.

Prop Fairing for P-51

Propeller blades, faired with a cuff "molded of a very light synthetic hard rubber sponge covered with a layer of erosion resistant material," Hamilton Standard Propellers announces, are now in production for North American P-51 *Mustangs*.

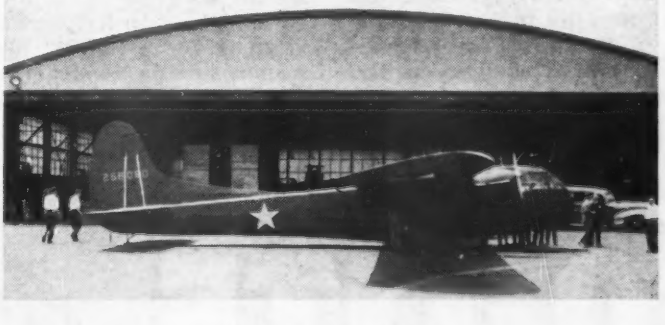
Attached to the shank, or inboard portion, of the blade, the cuff produces "some improvement in the over-all efficiency of the propeller and a resulting increase in top speed of the plane due to an improved fineness ratio at the shank of the blade," the company reports. The installation weighs from 4 to 6 lb. per blade.



Changed shape imparted by synthetic rubber sponge is shown in new blade (left) manufactured by Hamilton Standard. Aim is better cooling, efficiency, and airspeed.

While fairings are being used on the liquid-cooled P-51, their principal purpose is to improve cooling of air-cooled engines during warm-up and in flight. (For details of manufacturing procedure, see p. 167 October AVIATION.)

Hamilton also announces that its production of warplane propellers has multiplied more than 24 times since Sept., 1939. Including output of licensees, it will be 60 times at the beginning of the year. The company has just opened a new plant at Pawtucket, R. I.



POWER GLIDER TESTED

Power glider of CG-4A type recently given test flight at Newark Air Base. It was built by Ridgefield Mfg. Corp., Ridgefield, N. J., as an AAF experimental project. Its two wing engines are demountable. First CG-4A with power was devised by engineers of Northwestern Aeronautical Corp. who installed two 130 hp. engines built by Aircooled Motors Corp.

Bomber Crew and Fighter Pilot

Our airmen know the importance of planes that set new and superlative records of performance. Machines as well as men can outmatch the enemy.

Wire plays its part—it forms a giant nervous system in excess of 10 miles in length in the Axis-smashing Super Bombers. This complicated system which controls ignition, power, lighting and instrument installations can be—and *has been*—completely precision engineered.

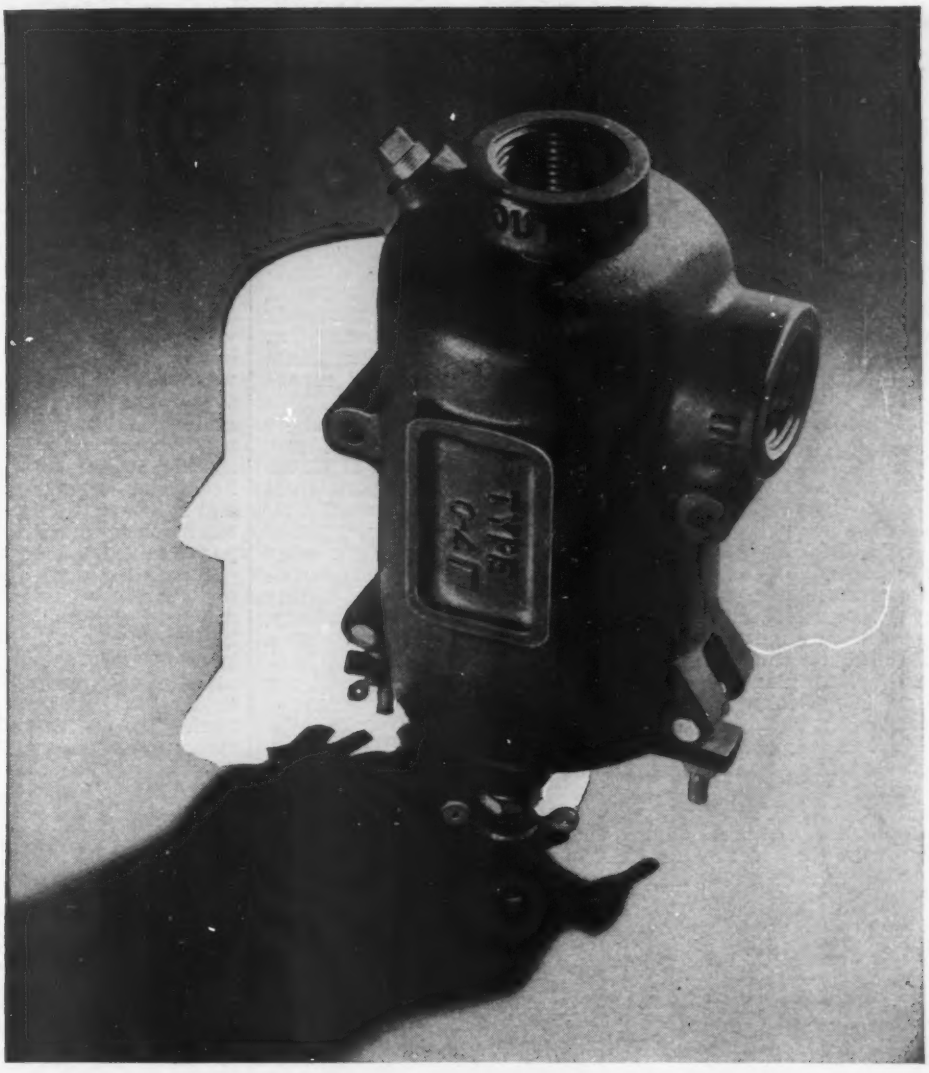
For the high tension system, Auto-Lite supplies Steelductor, now the choice of engineers for the majority of bombers and fighting planes. Details are given in Form No. C-503. Details of wire and cable for low tension systems are given in Form No. 838. We'd appreciate your making sure these valuable bulletins are in your file. They will be mailed promptly on request.

SARNIA, ONTARIO — **THE ELECTRIC AUTO-LITE COMPANY** — PORT HURON, MICH.

Wire Division

AUTO-LITE AIRCRAFT WIRE and CABLE

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR



FUEL STRAINERS – AIR CORPS TYPES

Air Associates has the complete range of Aircraft Fuel Strainers in full production. Included are types C-1A, C-2A, C-3, C-3A, C-4, C-4A, C-5, C-5A and various special modifications of these standard types . . . *All are manufactured in accordance with latest revisions of Army and Navy Drawings and to latest manufacturing specifications* . . . Body design permits right or left hand mounting. Drain cocks are provided in the base. Screens, of monel metal, are easily removable for inspection or cleaning . . . Present production schedules permit the acceptance of additional orders for early delivery . . . Inquiries invited.

AIR ASSOCIATES, INC.

TETERBORO, N. J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

Plans for More C-46's, 25,000th Buick P & W Among the Month's Production Highlights

Plans for increased production of C-46 *Commandos* and the delivery by Buick of the 25,000th *Liberator* engine are among last month's production notes released by manufacturers.

Curtiss-Wright and Higgins Aircraft, in cooperation with AAF, says B. S. Wright, director of C-W's Airplane Div., will produce C-46's on the largest scale ever contemplated in the manufacture of transports. No figures have been released, but work will be carried on in Curtiss plants in Buffalo, where the planes are already being produced, in St. Louis and Louisville and in a Higgins factory near New Orleans. Both companies will build complete planes. Under separate license, Higgins will make outer wing panels for Curtiss Buffalo plants, and the Louisville C-W factory will produce the same parts for St. Louis. Members of an executive committee, named to coordinate the activities of the various plants, are Col. Orval R. Cook, Production Div., Materiel Command, Wright Field; John J. Lee, manufacturing developments manager for C-W Airplane Div., with R. G. Miller, *Commando* coordinator, as alternate; and George A. Allward, chief Higgins aeronautical engineer. His alternate will be F. O. Higgins, production vice-president.

The Higgins factory, dedicated only a few weeks ago, was built on the site of the company's shipyard abandoned when the Maritime Commission cancelled a contract for 200 Liberty vessels some time ago. The plant cost $27,000,000 and was originally scheduled to build C-W C-76 *Caravans*, which were recently discontinued in favor of *Commandos*.

At least 60 percent of its Newark, N. J., personnel, Brewster announces, is working on C-46 wing ribs, spars, and engine nacelles under subcontract.

In announcing completion, in less than 21 months, of the 25,000th Pratt & Whitney R-1830-43 1,200 hp. radial for Consclidated Vultee *Liberators*, Harlow H. Curtice, director of General Motors' Buick division, said he believed the record had been achieved with the lowest man-hour–horsepower ratio on record. All engines manufactured to date, he said, have been accepted by AAF.

Another General Motors subsidiary, AC Spark Plug, reports that in building many thousand British-designed bomb sights for RAF and lend-lease planes in the last 15 months, production time has been cut one-third. Manufacture and assembly of some 4,200 parts was broken down into assemblies to be produced by subcontractors.

Because its North Michigan plant is going into production of Rolls Royce *Merlin* engines, Continental Aviation & Engineering is shifting work on a radial power plant previously built there to a factory at Garland, Texas. Both plants are scheduled for full capacity work.

Construction, scheduled to be completed by next April, has been begun on a $1,225,000 addition to an experimental building at Consolidated Vultee's Fort Worth plant. Spanning 300x300 with 60-ft. doors opening full width, the building will contain load testing scales of 150-tons capacity, five times the weight of a *Liberator*. . . . New test hangar has been completed for Curtiss-Wright's Propeller Div. at Caldwell-Wright (N. J.) Airport.

Practically the entire facilities of Lockheed are being devoted to production of *Lightnings*. . . . On a tour of Grumman plants, Rear Adm. D. C. Ramsay, chief of Naval Bureau of Aeronautics, recently called the *Hellcat* fighter "one of the best in the world. We consider the Grumman plane will play a successful part in the prosecution of the war against the entire Axis," he added. Whether this statement included Germany, he did not say.

Also in the visiting party was Representative Harry K. Sheppard, chairman of the House Naval Appropriations Committee, who gave it as his opinion that Grumman's was probably a "model plant not only in production but in lack of absenteeism."

Full-scale production of bomber wings has begun in the new South Scranton, Pa., plant of Murray Corp. of America. . . . Defense Plant Corp. has advanced $900,000 to American Propeller Corp., subsidiary of The Aviation Corp., for new equipment.

"Mars" to Navy

Glenn L. Martin Co. has delivered its 70-ton flying boat *Mars* to the Navy for further tests looking to its use in Naval Air Transport Service.

Designed for patrol work, the plane has been altered for transport service. On a recent endurance test flight, which lasted 32 hr. 17 min. over 4,600 mi., she took off with total weight of 141,000 lb. which included 22 passengers and fuel tanks not quite full. In another pre-delivery test, the plane, with a wingspread of 200 ft. and hull 117 ft. long, power dived from 13,000 ft., pulling out at more than 3G. Four Wright *Cyclone* 18's develop more than 8,000 hp., cargo load is put at 15 American tons.

Bendix Announces New Type Compass

A new type compass, known as the gyro flux gate compass, which gives accurate readings without lag through maneuvers up to 65 deg. from horizontal has been revealed by Bendix Aviation Corp. The new device, described as a significant advance in the field, is in volume production and has been used on American bombers for more than the past year and a half.

The flux gate unit utilizes a new principle in which the conventional swinging needle is replaced by a fixed coil system using energy generated by the earth's magnetic field. With power supplied from the aircraft's electric system, this energy is amplified to operate the reading device. It is, in effect, a combination of two units: The flux gate itself, mounted on a gyroscope to keep it in a constant position relative to the earth's field, and the receiving unit, or reading dial.

The compass is reported to give accurate readings without tending to "overshoot" or "hunt." It can be used to within less than 5 deg. of the magnetic pole, compared to approximately 20 deg. with the conventional magnetic compass.

The flux gate can be located anywhere in the aircraft. It can thus be removed from sources of interference, a fact which might simplify airframe design problems. As many as six remote reading dials, connected with the master unit, can be operated simultaneously. Corrections can be made for both variation and deviation, with the remote control units always giving the same readings as the master unit.

Conversion Plans

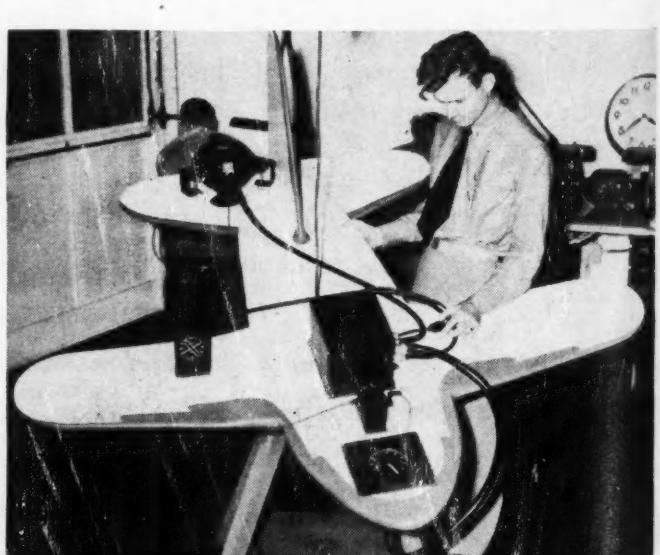
A program for postwar manufacture of hydraulic valves and companion equipment for buses, trucks, and trailers has been announced by Aircraft Accessories Corp., which is now producing aircraft hydraulic apparatus in Burbank, Calif., and radio equipment in Kansas City, Kan., and Slater, Mo. An automotive valve now being tested in the company's laboratory is said to weigh only one-fourth as much as those being used now.

Westinghouse has a planning committee surveying conversion, postwar markets, and the consequent needs for materials and personnel.

Martin-Nebraska Gets New Contract

In connection with new and important production assignments by the Army to the Glenn L. Martin Co., Joseph T. Hartson, formerly executive vice-president of the firm, has been elected president of Glenn L. Martin-Nebraska Co. at Omaha, succeeding Mr. Martin in that office.

The Nebraska plant is tapering off output of B-26 medium



At Philadelphia division of Bendix Aviation where new gyro flux gate compass is being produced for Army and Navy, Lt. (jg) T. A. Johnston shows parts of new device which can be located in most convenient part of plane. In September, this Bendix factory produced 175,000 instruments, and more are being shipped in six hours, it is reported, than the industry produced in a month before 1940.

PRODUCTION-BATTLE CITATIONS

★ Four Stars ★
WESTINGHOUSE
(Jersey City, N. J.)

★ Three Stars ★
LODGE & SHIPLEY

★ Two Stars ★
FARREL-BIRMINGHAM CO.
BULLARD CO.
GREENFIELD TAP & DIE CORP.
WESTINGHOUSE (Eight Plants)

★ One Star ★
CLAROSTAT MFG. CO.
WESTERN GEAR WORKS
Army-Navy "E"
AMERICAN VISCOSE CORP.
(Royal Front, Va.)
AVEY DRILLING MACHERY CO.
BAKEWELL AIRCRAFT PRODUCTS
BINKS MFG. CO.
BLACKHAWK MFG. CO.
CHELSEA CLOCK CO.
COOK ELECTRIC CO.
CRESCENT PANEL CO.
DAYTON TOOL & ENGRAVING CO.
E. I. DU PONT DE NEMOURS
(Plastics Dept., Arlington, N. J.)
ERIE RESISTOR CORP.
GENERAL MOTORS
(Warren, Ohio)
B. F. GOODRICH (Oaks, Pa.)
LINK-BELT (Caldwell Plant, Chicago)
MILWAUKEE FLUSH VALVE CO.
HERMAN NELSON CORP.
NEW YORK RUBBER CO.
WILLSON PRODUCTS
UNITED AIRCRAFT
(Chance Vought Div.)

bombers and a new heavy bomber will be made there in its place. Production of the B-26 will continue at Baltimore, Martin says, adding, "Our over-all responsibilities at Baltimore will be increased."

It is believed that Martin has been assigned the production of a new aircraft for the Navy. A group of high Naval officers, headed by two admirals, recently met with the management at Baltimore to "announce their new requirements and to urge intensified efforts."

JOSEPH T. HARTSON
New Martin-Nebraska president. He joined Martin organization in 1935, previously was an officer of Boeing, with which he started in '17.

Management Organization For Three Coast Producers

New organizational set-up of three aviation concerns is announced by Earl Herring, president and general manager of Airplane Mfg. & Supply Corp., the company managing the group.

The managing concern, under the name Amsco, will direct three producing companies: Pacific Airmotive, engaged in airplane and engine overhaul work since 1927; the Manufacturing Div. of Airplane Mfg. & Supply, maker of tools and testing equipment; and Airplane Parts & Supplies, for the past ten years distributor of new and reconditioned parts.

Executive offices are at 409 N. Brand Blvd., Glendale, Calif.

★ FOR THE RECORD ★

Swedlow Aeroplastic Corp., Marco Chemicals, and **Continental Can** are pooling their facilities for making parts of MR synthetic resins. Marco resin liners are now used in many fuel tanks.

Link-Belt Co. has purchased the plant and inventory of Link Belt Supply Co., Minneapolis. Ray S. Wood has been made manager. No other personnel changes are contemplated.

Speedwall Co., Seattle, plywood panel manufacturing company now doing aircraft parts work, has been purchased by Timber Structures, Inc.

Detroit Tap and Tool Co. announces opening of factory branch office in Toledo.

Hockaday Aircraft Corp., Burbank, Calif., has purchased Hockaday-Newby Aircraft, Inc. Noel R. Hockaday, former president of the latter, will be president and general manager of the new company.

P & W Airways, Inc., has been formed in Buffalo by George King, Jr., president; Edward I. Zolte, vice-president and secretary; and Daniel Magee, treasurer, to provide flight instruction in the Niagara frontier area.

John R. Cassell Co., New York City, has added industrial photographic materials to its regular line of drafting and reproducing supplies.

Hub Industries, Inc., has established a development division in Stamford, Conn., to explore general postwar applications of hydraulic apparatus, its present product.

Carbide Alloy Corp., New York City, recently acquired by Allegheny Ludlum Steel Corp., will be operated as Allegheny's Carbide Div.

SEE "AEROSCREW" FOR...

STEEL DRILLED HEAD AIRCRAFT BOLTS

Generally known as "Engine Bolts" and widely used in aircraft construction where bolts with heads drilled to accommodate lock wire are required. Holes drilled through all faces to meet center hole in top of hexagon head. Made of heat-treated nickel steel to conform with Army-Navy specifications, in types AN73 through AN81 and sizes up to 6" length. Also in coarse thread (NC3) or fine thread (NF3) styles. Carefully inspected and tested for quality, accuracy, and uniformity. Cadmium plating conforms to AN-QQ-P-421. Identified by "X" on head.

DRILLED FILLISTER HEAD MACHINE SCREWS

Used in many assembly operations and hence available in several types and a wide range of sizes. Low-carbon screws, for ordinary uses where high strength and close tolerances are not required, made to Air Force drawings AC500A and AC501A. Heat-treated nickel steel screws, for more particular applications where screws are appreciably stressed, conform to Army-Navy drawings AN502 and AC503. For close positions, where double cross-drilling is desirable, nickel steel screws conform to Navy drawing NAF-1164. Plating is bright and uniform. Nickel steel items identified by "X" on head.

We are Specialists . . .

in the manufacture of selected items of aircraft hardware. In addition to the above, we can furnish high-quality Hexagon Head Bolts, Clevis Bolts and Pins, Washer Head Screws, and Threaded Taper Pins.

Write for Catalog and Engineering Data

AERO SCREW COMPANY

19th Ave. at 12th St., Rockford, Illinois

In this sea-air war . . .

HYDRODYNAMIC EFFICIENCY

in a seaplane float is vital

On every sea-air front, seaplane take-offs and landings are smoother, swifter and surer because of Edo's advancements in the design and engineering of float gear.

Note the fluted bottom of an Edo float —an original and patented Edo development. As speed in the water is gained and the float rises on the step, the water is thrown off *at the first flute*. This reduces the wetted area to a minimum and enables the seaplane to break loose readily from the water. Precious seconds are saved in take-off. This action is illustrated in photos Nos. 1 and 2 taken during the tow basin tests of a scale model.

Exhaustive tests of this nature in which the action of wing lift and other actual flight conditions are simulated, accurately disclose the *hydro*dynamic characteristics of a new float model—pitching moment, angle of trim, lift, drag, etc. In wind tunnel tests, *aero*dynamic characteristics are checked with the same scientific thoroughness—see photo No. 3.

In developing new float designs for the high-performance airplanes of our Armed Forces, Edo does not rest on its unmatched experience of past years. Much of the credit for the fine war record of Edo military floats in meeting the exacting requirements of tropics-to-arctic service is due to scientific research carried on unremittingly.

EDO AIRCRAFT CORPORATION, 402 SECOND STREET, COLLEGE POINT, L. I., N. Y.

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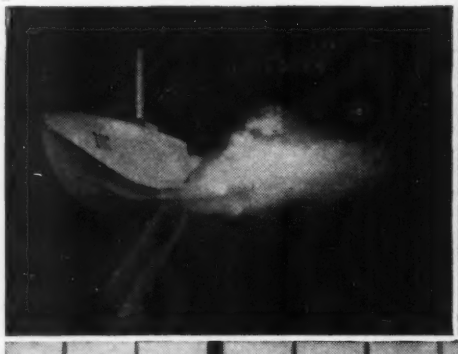

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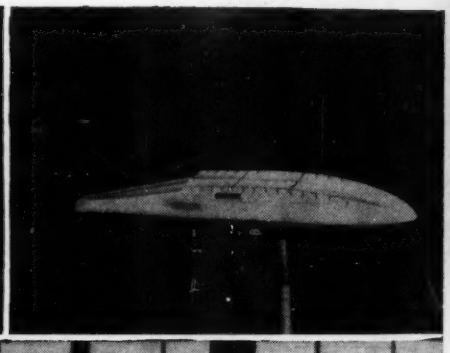


★ EDO FLOAT GEAR ★

SERVES THE UNITED NATIONS

PAINTED FOR ELECTRONIC LABORATORIES, INC., BY BENTON CLARK

NOT HERE, Hirohito!

● **So sorry, son of heaven, but the answer is "NO! You can't land here!"** . . . Not with these gallant little sluggers, the PT boats, on the job. They're tough. They're fast. They never sleep. And whatever the occasion demands, they've got what it takes.

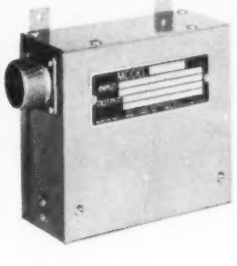
As a concentrated package of poison for the Axis, the PT boats are an outstanding example of the way American engineers, workers and management are teaming together to produce the deadliest weapons the world has ever known. And naturally, we're proud that ***E·L*** equipment is giving a good account of itself on PT boats.

The widespread use of ***E·L*** Vibrator Power Supplies as standard equipment—on land, sea and air—for radio, lighting, communications, etc.—wherever electric current must be changed in voltage, frequency or type—is evidence of the efficiency and rugged dependability of ***E·L*** products.

Electronic
LABORATORIES, INC.
INDIANAPOLIS

E·L **ELECTRICAL PRODUCTS**—Vibrator Power Supplies for Communications . . . Lighting . . . Electric Motor Operation . . . Electric, Electronic and other Equipment . . . on Land, Sea or in the Air.

E-L Timer for Operating Tail-lights and Wing Lights on Aircraft— *E·L* Model S-1372 causes tail-lights to blink alternately, 1½ seconds each. No rotating equipment is involved in the action of this device. Power capacity is optional. Operates on 28 V DC. Dimensions: 5¼″ x 2¼″ x 5″. Wgt.: 1½ pounds.



Resolved...

AS America enters the third year of this war for freedom, her people are resolved to hasten the hour of ultimate Victory by doing all in their power to give our fighting men the tools they need to win. Here at Breeze that resolution is reflected in the ever-increasing quantities of vitally important equipment flowing from the plants to the battle fronts. Breeze Radio Ignition Shielding, Flexible Conduit and Fittings, Multiple Electrical Connectors, and Cartridge-Type Engine Starters are among the many products engineered and developed by Breeze research that are now in service with the forces of the United Nations, on land, on the sea, and in the air. The dependable performance of this vital equipment is helping day by day to bring Victory closer to America and her Allies.

BREEZE CORPORATIONS, INC., NEWARK, NEW JERSEY

Breeze

BREEZE MARK

CAB Searches for Policy as Lea Bill Is Reported and Applications Reach 500

Washington (AVIATION Bureau)—Seeking the basis of a policy to handle multitudinous applications for postwar feeder air routes, Civil Aeronautics Board recently held general hearings at which it listened to the opinions of airline operators, railroad and bus men, inventors, engineers, statisticians, and other interested persons.

Just as the hearings concluded the number of applications reached the 500 mark.

Officials of the Board said that the testimony gave them valuable information, but that until it was coordinated and analyzed they still could not set up a formula which would dispose justly of the applications. Although the country admittedly will be spider-webbed with mail-express pickup services and short feeder lines, still, most of the proposed operations will have to be turned down. A great many of them are duplications, and many others cannot be proved necessary.

A majority of the applications are for operations by new companies; a lesser number are for route extensions by amendment to existing certificates. When the total stood at 500, 282 could readily be classed as new operations, 112 as amendments. Airline operators feel that they could handle all of the necessary expansion. Fixed-base people, air schools, and would-be airmen feel that the feeder system ought to be awarded to local operators. This is a difficult decision which the Board will have to make. Indeed, no general conclusion may be possible; many cases may have to be decided on their own merits. All in the aviation group agree on one point: That the bus and rail people should be kept out.

The Board is now acting on only those applications that will directly facilitate the war—there are very few of them—though many claims are made to that effect. The board has also invited applications for routes from the U. S. to the Caribbean.

Any action CAB might take on proposals of surface cerriers to enter air transport would not be conclusive because of the pending Lea legislation, which is highly controversial and may not be settled for a long time. Furthermore, there would be no equipment available even if new routes were authorized by the Board.

The Lea bill, which would revise the Civil Aeronautics Act, was reported favorably to the House, but the controversial amendments of Section 408, covering participation of surface carriers in air transport, were first removed and put into a separate bill, HR 3421. Hearings had not been scheduled on the latter at this writing. A third bill, introduced by Rep. B. Carroll Reece, (Rep., Tenn.) supports "states rights," control of the Board by the Commerce Department, and upholds the claims of surface transportation—which the Lea bill does not do.

Postwar Prospects

Opinion differs concerning the immediate postwar prospects of air transport. W. A. Patterson, president of United, recently stated that average passenger rates of 5.1c. cannot be reduced enough for 10 or 15 yr. to compete against cheaper transportation. C. Bedell Monro, Penn-Central president, predicts that the airlines' prewar total of 350 planes will be nearly tripled to 1,000 within three years after the war.

Opinion indicates that it will be three or more years after the war before new transport plane designs are available. Meanwhile, the Air Transport Assn. and Air Cargo, Inc., are drawing up performance specifications, for the benefit of manufacturers, of planes wanted in the future. They are also urging the government to make provision for supply of parts for military cargo planes to be converted to airline use during the immediate postwar period. Available planes listed by Mr. Monro are the DC-3 (Army C-47), Curtiss *Commando* (Army C-46), DC-4 (Army C-54), and Lockheed *Constellation*. Doubtless different authorities would suggest others.

Applications

Meanwhile, Missouri Pacific Lines and Texas & Pacific Railway presented CAB with their proposed solution of the surface-air controversy: Eagle Airlines, a subsidiary company interconnecting with rail lines on 16 routes over 6,000 mi. Stops would be made at 108 cities, with through service contemplated to the Eastern Seaboard, Pacific Coast, and Mexico.

In New York, the 30th National Foreign Trade convention adopted a resolution declaring that "participation, ownership, or operation by American shipping companies in overseas aviation should not be prohibited by law or by administrative regulation when found to be in the public interest."

Recent route applications submitted to Civil Aeronautics Board included:

Braniff: Transcontinental service from Los Angeles to Washington, New York, and Boston, with stops at Albuquerque, Amarillo, Oklahoma City, Tulsa, St. Louis, Cincinnati, Baltimore, Philadelphia, Pittsburgh, and Columbus.

Chicago & Southern: New Orleans to Rio de Janeiro and Buenos Aires.

Colonial: Washington, D. C. to Portland, Me.

Continental: Memphis to Kansas City and Tulsa. Route extensions from Denver to Los Angeles.

Delta: Kansas City to New Orleans; Birmingham to Dallas and Fort Worth.

Northwest: Seattle to Honolulu.

Parks Air College: Feeder service in area bounded roughly by Minneapolis and Detroit and Dallas and Albuquerque involving 35 routes of about 500 mi. each.

Southair, Inc.: 17 routes to 110 cities in the South and Southwest.

TWA: Amended application for route to Cairo via the Azores. In U.S., Emporia, Kan., as transcontinental stop.

Wm. Filene's Sons Co., Boston department store: Helicopter service on six routes to 45 New England communities.

At least a score of applications have been filed for lines from the U. S. southward by most of the companies operating in the east and south of the border. Three foreign applications have been received for entry into this country from the south. A good many of them were placed in response to a request by the President. A pre-hearing conference on the group has been held by the board.

HEMISPHERE NEIGHBORS DINE

At a luncheon given at the Wings Club, New York, by Pan American and Pan American-Grace Airways for visiting South American Naval officers were (top row, left to right): John P. Lee, Office of Coordinator of Inter-American Affairs; Ens. Gambetta Banchero, Peru; Cadet Caio Amorin Pontual, Brazil; Ens. Jose Barandiaran Movoa, Peru; Ens. Javier de Cossio Tudels, Peru; Ens. Guillermo de la Flor Valle, Peru; Lt. Robert Parrangu, Chile; and Lt. J. P. Irish, USN. Middle row: Charles Ogle, Office of Coordinator of Inter-American Affairs; Lt. Leonard Janofsky, USN; Cadet Frederico Clark Nunes, Brazil; F. B. Foulke, Panagra; Lt. Hernan Lopez Angulo, Chile; Howard Aller, Jr., and J. H. Torrens, Panagra; J. L. Moloney, PAA; Ens. Pio Davila Romero, Peru; Lt. Alfredo Gomez-Lobo Guevers, Chile; Ens. Enrique Shroth Carlin, Peru; Cadet Luis Ignaci Luderitz, Brazil. Seated: F. S. Adams, PAA; Lt. Rolando Honorato Chapparre, Chile; Ens. Luis Barandiaran Pagador, Peru; Oscar Balz, Panagra; Ens. Juan Salaverry Ramos, Peru; Cadet Jose Durvalde Souza e Silva, Brazil; Capt. Ernesto Romaro, Chile; Erwin Balluder, PAA; and Ens. Omar Chioino Carranza, Peru.

British Want Some International Authority, But Nature of Air Control Is Still Undefined

Washington (AVIATION Bureau)—Working toward an Allied world air program, a British air transport committee has concluded a preliminary conference at which it unanimously agreed to recommend an international air transport authority of some sort (also see p. 291). Meanwhile, in the United States, the President's Interdepartmental Committee on Postwar Aviation has placed its recommendation on the desk of State Secretary Cordell Hull, but a strong minority report went with it. Russia appears not to have reached any conclusions. Other countries will not come into the picture till later.

A meeting of U. S. and British officials on postwar aviation was being planned for Washington at this writing. Very little agreement was expected to come from it. The British are split, despite their unanimous committee agreement, on the issue of private or public ownership; they lean toward the latter. We disagree on whether a single or multiple foreign service is desirable. That question has divided the President's interdepartmental committee, with Chairman Adolf Berle (Assistant Secretary of State) on the multiple service side.

The State Department itself is in disagreement. One faction sides with the Pan American-United Air Lines group which wants to pool facilities under a single management, the other faction with the 16 domestic airlines who want competitive foreign flying. State Department and CAB recently issued a joint statement setting definite lines between their realms of authority and declaring in effect that PAA itself can no longer negotiate with foreign countries for air rights—which shows that the pro-competition State faction is in the saddle.

International aviation is now assuming the role so long played by domestic aviation: It will become a buffer on political fronts. The aviation cards are all aces and faces, and they will be held by top men and played when they will count for the most chips. There is no reason to expect anything but uncertainty and change in international air transport for years to come.

But some principles will take shape. Leaders in this country expect freedom of the air will evolve into the right to fly non-stop over any country without special permission. Emergency landings, of course, must be accepted. If this right of innocent passage is agreed upon, the question of bases will be unimportant: All will use them.

It seems probable that Germany and Japan will be allowed only intra-border transport operations and no aircraft industry whatever.

8c. Airmail?

Seeking ways to touch the citizen for more revenue without mashing incomes to a further pulp, House Ways and Means Committee advises a new airmail rate of 8c. per oz. after rejecting a 10c. rate.

While tax bills generally pass the House without substantial changes, they are often extensively rewritten in the Senate. No comment on the proposed mail increase has been made by any legislators.

"Community Company" Recommended by Trippe

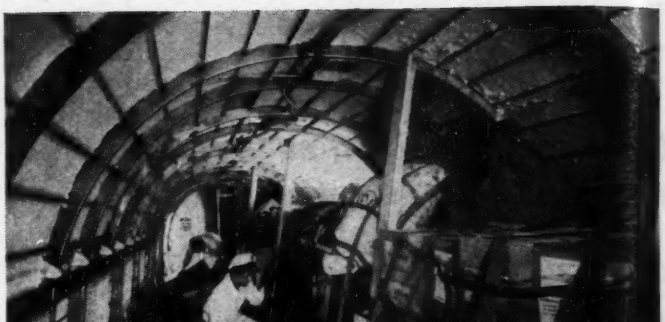
Need for the government to establish an international air policy and the participation of this country in overseas flying through a company jointly owned by various American interests, were urged by Juan T. Trippe, president of Pan American Airways, before the recent 30th Annual National Foreign Trade Convention in New York at which he received the Capt. Robert Dollar Award for "for his distinguished contribution to the advancement of American foreign trade."

Mr. Trippe, whose company (along with United and American Export) was not among the recent 16 signatories to a recommendation for competition abroad, stated PAA's position in the form of a question. While foreign nations support air transport monopolies, shouldn't we, he asked, have "one strong international airline—a community company—owned and controlled not by any one aviation interest but by all American transportation interests able to contribute under an organization plan approved by the government?"

Court Studies Tax

The transport industry is awaiting with interest the ruling of the U. S. Supreme Court on the appeal of Northwest Airlines from a decision of the Minnesota Supreme Court holding it liable to a 100 percent *ad valorem* state property tax on all its planes.

This will be the first high court action in the complex matter of airline taxation, and should furnish a precedent for all future local legislation. It should also clarify the multiple taxation threat to interstate air commerce and give state authorities their first pattern for assessment. Historically the court has ruled against local taxation assessed against property owned by a corporation in several states.



CARGO ACCOMMODATIONS

Plywood floors and sidings, steel-screened windows, and bins—large versions of the nets that hold your shoes in an upper berth—have replaced chairs and other luxuries in this United DC-3 converted to cargo service and now making one daily roundtrip between New York and San Francisco. Loads have run as high as 6,500 lb. compared to "Mainliner's" average of 1,400 lb. of cargo. TWA has also inaugurated cargo service between Kansas City and Los Angeles.

Transport Conversions Called too Expensive

Chicago (Special to AVIATION)—Efficiency advantages of new air transport planes will make conversion of Army transports uneconomical, Edward Wells, Boeing chief engineer, told an air cargo meeting of the Society of Automotive Engineers in session here. Even if military transports were turned over to airlines gratis, he said, new cargo designs could compete favorably with them on a cost basis; conversion of *Fortresses* and *Liberators* into transports would be still more costly and would not be worth their resulting limited utility.

Wells described three designs for peace service: 1. A four-engine, 5,600 hp. plane with payload of 26,000 lb. and range of 1,200 mi. with performance between that of the C-47 and the C-54; 2. A smaller four-engine plane; and 3. A twin-engine transport. The latter two would have the same payload as the C-54—10,000 lb. of passengers and cargo. The big plane could carry a 30,000 lb. payload with operating cost of 6 to 7c. a ton-mile and passenger cost 2¼ to 2½c. a passenger-mile.

Carlos Wood, chief of preliminary design, Douglas Aircraft, predicted an "enormous increase" in air cargo as soon as rates were reduced as a result of improved planes and operating practices. Eventually, he predicted, domestic cargo planes will have high-wings and floors close to the ground; transoceanic types will be low-winged because of better emergency water-landing characteristics. He described plans for a convertible cargo-passenger cabin with moveable bulkheads and seats which would allow from 80 to 90 percent of payload to be carried either in cargo or passengers.

Limitations on size of single-rotor helicopters because of tip speed, load capacity, and experiments with two-rotor helicopters, still in an early stage, were discussed by Waldo Waterman, chief of design, Stout Research Laboratories. His company's design has not yet been flown, he said. He described various helicopter developments, citing the P-V Engineering Forum's model (p. 229 Nov., AVIATION) as one of the most successful. He also mentioned a Bell Aircraft model, now being flight-tested, and the Platt-Le Page dual-rotor 'copter, and he expressed the opinion that counter-rotating blades are not as suitable as single ones. Icing on rotor blades creates a serious problem, he said.

Col. Harold R. Harris, of the Air Transport Command, objected to pessimism among aviation people on postwar conditions.

On the other hand, William A. M. Burden, special aviation assistant to the secretary of commerce, warned that there will be a sharp decline in air transport tonnage when peace comes, but declared that the size and length of the decline would depend on imagination and perseverance.

Expect U. N. Conference To Clarify Air Policies

Though at this writing Britain's Empire Air Conference is history, there is still confusion, as far as the public is concerned, as to the precise approach decided on at the meeting for effecting an equitable postwar international air transport policy.

Publication of all points discussed is very likely to be held up for some time to come—that is, pending an international air transport meeting with Russia, England, and the U. S. participating, which is expected to take place in the near future.

The conference ended with the mere official statement that the decisions upon which the British, Indian, and Dominion representatives agreed still required approval by the respective governments. But the fact that Conference Chairman Lord Beaverbrook and Minister of War Transport Lord Leathers later were reported planning to come to Washington indicated that such approval had been obtained.

Still, the only inkling of the conference decisions was Lord Beaverbrook's expression that it was agreed that some kind of international air transport authority should be responsible to a United Nations security organization, which might be established.

During the conference, public discussions, sometimes violent, revolved about proposals for U. S.-British parity and "American dominance over British airlines." General scares about U. S. postwar plans were accented by reports in America by traveling senators and speeches by persons generally highly regarded in London.

Meanwhile, the N. Y. Chamber of Commerce stated that, as regards the lend-lease airports abroad, a treaty ought to establish the right of transit for commercial craft, plus rights to land, refuel, and stop overnight. Under usual conditions, such a proposal would hardly have aroused more than casual comment, but just at this time the State Department said it would use diplomatic influence to help U. S. airlines obtain foreign rights—and so there was some new mistrust of intentions.

Main solution to the situation seems to lie in an early convening of the United Nations conference considering international air commerce—a meeting where all problems can be aired and at least a basic agreement reached.

New Competition for PAA

First major competition with PAA by an airline under U. S. control loomed large on the South American horizon last month when a group of American investors, including TWA and Time, Inc., purchased a 51 percent controlling interest in Inter American Airways, holding company for a group of airlines started and developed by Lowell Yerex.

Main segments of Inter American are TACA., Central American airline; Britain's BWIA., which holds a permit for a Miami route; and a small line in Brazil, Aerovias Brasil.

Lowell Yerex becomes president for the next ten years of the new company.

BOAC Targeted

Lately, it is becoming apparent that BOAC may not be the only "chosen instrument" for British air commerce. For it is notable that the company's continuous changes in management, together with rather unimaginative statements by Lord Knollys, the new managing director, have disappointed more than a few people.

C. G. Grey, for one, has put the finger on Lord Knollys' statement that Capetown might in the future be reached in as little as two days. Pointing out that the *Mosquito*, which BOAC is even now using, can cruise at 350 mph. in a commercial version, Grey says that South Africa can readily be brought within 20 hr. and Australia within 36.

On Schedule . . . by "Vista"

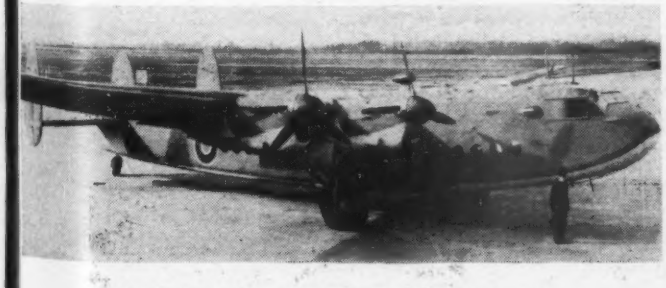
Coincident with the recent Empire Air Conference at London, British shipping lines have displayed new interest in postwar air transport. Several of the larger companies have held stockholders' meetings at which directors were voted powers to establish such services.

Primarily, the plans have concerned transatlantic routes, over which certain British sources expect traffic approaching 4,000 passengers per day within 10 yr. after the war. Of course, the urge of such companies as Cunard, Furness, and Manchester Liners to lay hands on at least a slice of such business is understandable—for there are those who say that come peace the prime utilities of surface liners will be haulage of tourist passengers and heavy freight.

It is noted that the Bristol Aeroplane Co. is developing a 130-ton "Queen Mary" of the skyways as a "spare time diversion," and a completely new type of passenger and freight air traffic is envisioned by the proponents of the project.

But not all the interest is restricted to the North Atlantic. Two British groups are cogitating on the waters to the south. One combination, consisting of five shipping lines whose names are little known here, has opened negotiations for an England-Brazil airline. Another similar South American plan is reported involving BOAC. And since discontinuance of the Italian services is considered an inconvenience (even if the "Eyeties" did play "spy ball" for the Germans) early action may be expected establishing direct connections between Britain and South America's largest republic.

In the Caribbean, only two of the five airlines which obtained emergency permits for passenger, mail, and freight service into the United States are now operating, namely Expreso Aereo Inter-Americano and KLM. Since these permits are now coming up for renewal, it is considered somewhat doubtful that the other lines (TACA, BWIA, and Cuba's CNCA) will obtain renewal of their papers—unless they definitely can start service within a minimum of time.



BRITAIN COMES UP WITH NEW AIRLINER

Tri-tailed Avro "York," new 50-passenger transport version of "Lancaster" bomber, lands in Canada after maiden Atlantic flight. Span of craft is same 102 ft. as that of bomber, but length is 78 ft. compared with military job's 69 ft. 2 in. New craft mounts four 1,240 hp. "Merlins." Among passengers on initial ocean trip was Avro Designer Roy Chadwick. Incidentally, "York" is not to be confused with converted "Lancaster" transports, such as currently employed by TCA. (International News photo.)

★INTERNATIONAL BRIEFS★

New British warplane protection is a trigger-operated, cartridge-driven "chisel" installed in the leading edge of the wing to cut barrage balloon cables before they can harm the plane hitting them.

The new Jap fighter reported giving our bombers a bit of trouble over China may be the Nakajima Army S-01. It's armed with only two 12.7 m.g.'s, but it has a 390-mi. top speed.

A French military airline now connects Damascus and Moscow. It carries mail and cargo for French airmen fighting with the Red Army.

Russia recently applied for permission to set up a direction finder at Cairo. This is probably the initial Russian participation in the London-Moscow aerial link.

Payne Field, one of the largest airports in the world, was recently opened in Egypt after being under construction for only **58 days.** It's main use will be accommodation of the increasing ATC traffic.

Loss of a second Swedish DC-3, operated by ABA between Stockholm and Scotland, has brought new Swedish-German tension, since this plane was shot down over Swedish water by a German fighter, reported to have been gunning for Moscow-bound Anthony Eden. Service was discontinued "until further notice."

Ala Roma, new name for the Italian line Ala Littoria, has now been changed again to Ala Italina.

Progress Report:

Automatic Exit Flap Control

Before Pearl Harbor

Memo to AiResearch Engineers:

Can exit flap control be made automatic? It would give greater freedom to pilots...and cut open-flap time considerably. Thus you can help reduce cooling drag and increase airplane speed.

1941

Many systems being designed and tested in our laboratories. Some problems now licked. New techniques of electrical operation being developed that look like the answer.

War Comes

AiResearch has the first system of Automatic Exit Flap Control tested and proven! Lightweight, simple in design, made of standard aircraft parts, it provides a 25° F. modulation range between flap open and flap closed. Powered by a new type of electrical circuit for high altitude operation, the system goes into service on America's fighting aircraft!

Still AiResearch engineers keep striving to make the best even better . . .

Now AiResearch Announces Another Advancement: "FLOATING CONTROL"

The improved AiResearch Automatic Exit Flap Control System is based on a new principle of proportionate rate control whereby the thermostat moves the actuator *directly* . . . at a rate in exact proportion to each change in temperature!

With temperature control constant, it further reduces open-flap time and cooling drag. And provides these additional advantages:

A 3° F. modulation range between flap open and closed.
Elimination of all relays and follow-up.
No vibration-sensitive contacts.
Weight-savings up to 20%.
Simplified wiring

Now fully flight-tested and ready for volume production, the new system is available for 24 volt D. C. or 400 cycle A. C. supply on exit flaps for oil coolers, intercoolers and Prestone radiators.

CONSTANTLY, AiResearch engineers are developing better ways to control air, temperature and pressure in high altitudes. If you have such a problem—for today's military aircraft, or tomorrow's commercial airliner–AiResearch offers you engineering assistance.

AiResearch
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"Where Controlled Air Does the Job" • Engine Oil Cooling Systems • Engine Air Intercooling Systems • Automatic Exit Flap Control Systems • Supercharger Aftercooling Systems • Engine Coolant Systems

Aviation Finance

Curtiss-Wright Corp. will stick to the aircraft business after the war and not branch out into other fields, Pres. Guy Vaughan told stockholders at the annual meeting. Except for research facilities, he added, Curtiss would be better off financially if the war had not come along.

Sperry Corp. is negotiating a $125,000,000 regulation VT-loan, according to Wall Street bankers. The Bankers Trust Co. and the Guaranty Trust Co. are scheduled to head the lending group. No announcement has been made by Sperry, but if the deal goes through it will be one of the largest wartime industrial loans.

Thompson Products is planning the sale of 45,000 new preferred shares to finance peacetime business and to retire the present convertible preferred stock, according to Pres. F. C. Crawford. The new stock is expected to carry a dividend rate of not more than 5 percent. There are 25,660 shares of the convertible perferred outstanding. Sales for the first six months of 1944 were $39,442,000 compared with $60,920,000 in all of 1942.

Dividends: Boeing Airplane Co. declared a $1 dividend payable Nov. 17 compared with $1 on Apr. 21 and a 1942 payment of $1 on July 23. Beech Aircraft Corp. also declared a $1 dividend on its common payable Oct. 28. An initial payment of a similar amount was made in Oct. 1942. Ryan Aeronautical Co. paid a 35c. dividend Nov. 26, bringing payments for the fiscal year ended Oct. 31 to 45c. a share. Consolidated Vultee paid a common stock dividend of 50c. on Nov. 1 as well as a preferred dividend of 34¼c. on Dec. 1. Bell Aircraft Corp. declared a 10 percent stock dividend (one share for every ten held) payable Dec. 2. Bell paid a $1 dividend on June 25.

Republic Aviation Corp. retired 100,000 shares of its second preferred stock on Oct. 1, leaving 50,000 shares still outstanding, according to Pres. W. Wallace Kellett. The preferred was called at $10 a share.

Northrop Aircraft showed sales of $69,791,844 for its fiscal year ended July 31, a gain of 112 percent over the $32,983,762 for the preceding year, Chairman LaMotte T. Cohu reveals. Net profit, however, declined to $1,249,535 or $3.12 a share from $3,044,741 or $7.93 a share. Backlog of unfilled orders totaled $133,065,747 and the report showed the company was using $14,500,000 of the $17,000,000 V-loan credit advanced by a banking syndicate.

Lockheed Aircraft Corp. has taken steps to absorb its wholly-owned subsidiary, Vega Aircraft Corp. Pres. Robert E. Gross reported the move was "simply a continuation of the trend towards closer integration in operations of both companies."

Fairchild Aircraft, Ltd. reports for the year ended June 30, net income of $38,386 or 30c. a share against $98,541 or 77c. a share in 1942.

TACA, central American airline holding company, plans a public stock offering totaling around $3,000,000, according to a Wall Street report. TWA is understood to have a 22 percent interest in the company, while Time, Inc., Adams Express Co., and Air Investors are said to have somewhat smaller holdings.

F. L. Jacobs Co. earned approximately $2,500,000 for the fiscal year ended July 31, according to Pres. R. C. Jacobs, who reports that dividend consideration has been postponed due to restrictions of the company's V-loan, greatly increased business with war agencies, and postwar business prospects.

Hayes Industries, Inc., reports for the year ended July 31, net profit of $648,016, equal to $1.95 per share, after estimated income and excess profits taxes of $2,125,000, less postwar refund of excess profits tax of $195,000. Net profit compares with $917,984, or $2.75 per share for the preceding fiscal year. Net sales for the fiscal year were $22,517,389, compared with net sales of $12,586,176 for the preceding period.

Panair do Brazil, Pan American Airways subsidiary, will offer for sale around $1,600,000 of stock to increase capitalization to $4,000,000, according to Pres. Paulo Sampaio. Up to 40 percent of the new stock will be sold to Brazilians and will not be transferable to foreigners or citizens born outside federal territory.

Continental Motors Corp. net profits for nine months ended July 31 amounted to $4,375,626, after all charges including income and excess profits taxes, depreciation, and reserves for charge-offs.

Stewart-Warner Corp.'s Pres. James S. Knowlton recently wrote stockholders advising that "a statement of earnings for the six months ended June 30, 1942 will not be issued now because we cannot fairly estimate the amount of earnings which may be refundable to the government in the renegotiation of our business as prime contractor, subcontractor, and supplier. Our 1942 earnings are still in the process of renegotiation. Shipments of vital war materials from our factories during the first six months of 1943 exceeded shipments in the same period of 1942 by approximately 59 percent."

Thompson Products reports net earnings of $1,408,152 or $4.53 a share for the six months to June 30 against $1,179,918 or $3.76 a share a year ago. Sales were $64,064,616 compared with $34,974,642 in the like 1942 period, with the aircraft subsidiary sales standing at $24,887,444 against $8,704,653 a year ago.

Aero Supply Co. had unfilled orders at the end of June totalling $16,508,000, while sales for the first half of 1943 were $10,178,635 against $7,885,130 in the first half of 1942.

Aeronautical Products reports net profits of $305,562 or $2.04 a share in the year to May 31 against $127,836 or $1.02 a share in the previous year.

Ex-Cell-O Corp. reports profits for the six months ended June 30 were $1,055,113 or $2.65 a share compared with $2,059,528 or $5.16 a share in 1942.

Aircraft Accessories Corp. has acquired a controlling interest in the **Phonette Co.** of America, Los Angeles, maker of radio components.

By RAYMOND L. HOADLEY

About Those "Airline Mergers" . . . Railways Form "Handy" Airline . . . Investors and Legislation . . . Manufacturers and the Excess Profits Tax . . . Why Not Sell the Workers On the Industry's Needs?

RUMORS OF MERGERS among the nation's domestic airlines are a "dime a dozen" these days, although few facts of these persistent reports can be nailed down. But this much is definite: Western Air Express has acquired approximately an 83 percent ownership of Inland Air Lines subject to CAB approval, while Northeast Airlines has purchased Mayflower Airlines.

Moreover, Wall Street had it that a fifth big air transport system, made up of Chicago & Southern, Delta, and National Airlines, has been discussed. But Pres. Carlton Putnam of Chicago & Southern said that no mergers were being considered by his company. So then Delta and National were promptly linked up with Continental.

W. A. Patterson of United predicted more than six months ago that the airlines were nearing the merger stage. And where there is so much smoke there undoubtedly is fire. Meanwhile, airline officials note with lifted eyebrows that the Missouri Pacific and Texas & Pacific railroads have formed Eagle Airlines—just to have handy in case the railroads are permitted by Congress to go into the air transport business.

Considering now the status of the aircraft investor: He will receive little or no benefit from any of the legislation Congress will complete before the Chrismas holidays. And as for the aircraft concerns: Further restrictions on the invested capital base for excess profits tax exemption won't bother them, since few, if any, have had enough invested capital to make it advisable to use the invested capital tax base. But if corporate taxes are raised from 90 to 95 percent of excess profits, the plane makers will suffer accordingly.

Unfinished Congressional business at the year-end probably will include action on the contract termination muddle, the Lea aviation bill, and renegotiation amendments to the tax laws. However, if the industry continues to plug for a fair deal on their tax problems, some relief may be forthcoming from Congress in 1944.

Congress is expected to begin work early next year on a new tax bill and 1944 is a general election year. The industry has done a good job of presenting its case to Congress. Very likely it now can cinch it—by doing a similar selling job to the nearly 2,000,000 aircraft workers who, it's pertinent to point out, are nearly all voters.

WAR HORSE WITH A *Kick*

North American's P-51 Mustang

Photo, courtesy North American Aviation, Inc.

It's the "wild west" of Europe now, since North American's P-51 flying "Mustangs" stampeded the range! Those rip-snorting, high-octane hay-burners bite hunks out of Heinkels, make messes out of Messerschmitts and junk out of Junkers so often that the rodeo is getting one-sided. Yes, siree, podner! – things are picking up in Fortress Europe – mostly Germans picking up the pieces!

Exactly to the liking of hell-for-leather Allied pilots is this wild-horsepower – engineer-tamed just sufficiently to out-chase, out-maneuver and out-fight anything the Axis has to offer. And although the Air Command keeps close to its vest the figures on the "Mustang's" super-qualities, you can bet that a major part of its high maneuverability is due to Fafnir Ball Bearings on the controls!

There could be no finer example of American engineering collaboration. Aircraft engineers expertly design each bearing point for maximum controllability. Fafnir engineers meet these requirements with the exact Fafnir Bearing necessary to give rigidity and friction-free performance. Victory is built on teamwork like this! The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

ARMY (E) NAVY

Send for copies Fafnir Aircraft Service Manual, you will find it an invaluable service guide.

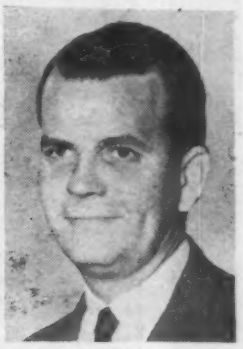
FAFNIR
Ball Bearings
for Aircraft
Engines and Controls

Aviation People

PAUL A. SCHERER, director of research of AiResearch Mfg. Co., has been granted an indefinite leave of absence to become chief of the Engineering & Transition Office of the National Defense Research Committee headed by Pres. J. B. Conant of Harvard University.

FRANK H. HARRISON, former manager of manufacturing for the International Harvester Co., and E. J. HARRINGTON (right) ex-coordinator of planning, production, and material problems for the Lockheed Aircraft Corp., have been elected vice-presidents of Curtiss-Wright Corp. Harrison, for the present, will make his headquarters at the Columbus plant and will be in complete charge of operations for the corporation at that point. Harrington, who will be located at the N. Y. offices as a member of the executive mfg. staff, is temporarily assigned to the Columbus factory.

CLINTON B. F. MACAULEY joined the public relations staff of Fairchild Engine & Airplane Corp. As asst. to Joseph E. Lowes, Jr., director of public relations he assumes editorship of The Pegasus, succeeding W. M. Kimball, who joins Cecil & Presbrey.



MORGAN C. MONROE was appointed director of industrial relations of the Farmingdale div. of Republic Aviation Corp. He will have direct supervision of the personnel, training, employment, job classification, medical, industrial safety, employee publication depts.

MAJ. REUBEN H. FLEET has been elected president of the Institute of the Aeronautical Sciences for the year 1944, succeeding Dr. Hugh L. Dryden. Although Maj. Fleet sold his interest in Consolidated Aircraft in 1941, he remains as consultant to the new management of Consolidated Vultee Aircraft.

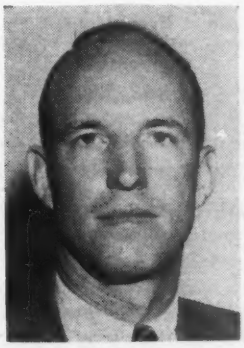
W. KENT WHEELER, formerly of the Martin and Solar and Lockheed Aircraft companies, has been appointed Dayton liaison representative of the manifold manufacturing division of Ryan Aeronautical Co. In the aircraft business for the past 16 yrs, he was assistant supervisor of production for Glenn L. Martin.

JAMES E. WEBB, who has been secretary and treasurer of Sperry Gyroscope Co., has been elected vice-president of the company. He will continue to serve as secretary, but is succeeded as treasurer by F. W. Kilduff, asst. treasurer, who is also director of government claims under terminated contracts.

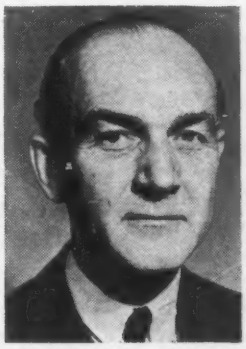
JOHN M. DEMAREST, consulting and plant engineer for the past 25 yr. and recently associated with WPB in charge of aircraft plant expansions, was named plant manager of Wright Aeronautical plants in the N. J. area. Before joining Wright as asst. to the general supt. he was I.B.M. plant engineer.

FRANK A. RUDOLPH who has been in charge of Aircraft Accessories Corp. New York offices, has been named Eastern regional manager. Through an error in the makeup, our October issue report of this change carried a photograph of ATA's Johnny Groves rather than the picture of Mr. Rudolph.

DR. EDWARD E. MINOR, JR., who has been elected a vice-president of All American Aviation, will head a newly created manufacturing and developmental division of the company. Before joining All American, Dr. Minor was development and design engineer with Glenn L. Martin.



WILLIAM L. WILSON, formerly director of industrial relations for Republic Aviation Corp., returns to Kellett Aircraft Corp. as assistant to the president. He will be assigned duties in several administrative fields, including supervision of the company's industrial relations and other programs.



ARTHUR READ CHRISTIE, with United Aircraft since 1939, has been named Washington representative of Pratt & Whitney and will direct liaison with government agencies. An extensive and colorful Army aviation career which began in 1914 preceded Mr. Christie's entry into business.

COL. ARNOLD RICH, USA Ret., has been appointed director and general manager of the technical division, Embry-Riddle School of Aviation. Rated a command pilot and combat and technical observer, he has logged approximately 3,000 flying hours. After being detailed to the Air Service in 1921, he served 7 yr. with the Air Corps Technical School, 7 with the Tactical School, and 3 with the Flying Schools. He retired from the Army in 1942. CARL R. ANDERSON (right) rejoined the organization as assistant vice-president, and will coordinate the work of the various promotion departments. (Ebbets photo.)

Evans Skyloader tie-down rods and beams lock heavy castings, barrels and odd-sized cargo securely in flight, while Evans rope hooks and tighteners tie down mixed cargo.

A combination of Evans Skyloader rope hooks and rods ties a jeep tightly to the deck of a cargo ship. On- and off-loading is made fast; weight of lashings is held to a minimum.

up in the cargo lanes

When giant cargo ships get "upstairs", run into the stresses and strains of flight through rough air, serious damage can befall plane, cargo and crew, unless the cargo is really made fast. For example, a sharp downdraft can lift an entire cargo off the deck of an airplane, with a resultant upward strain as much as 2.4 times greater than the cargo's weight! Evans Skyloader equipment will hold cargo firm against such a strain.

Evans Skyloader method is the most simple, effective system of tying down air cargo and *removing all slack!* Skyloader rope hooks and tighteners, as well as metal tie-down rods and beams, make it possible to handle all types and shapes of cargo, with a new security and safety that is proving its value to both military and commercial shippers.

Evans Skyloader equipment is designed to offset and solve all freight tie-down problems up in the cargo lanes, as well as to save priceless on and off loading time.

Our engineers will gladly study your special air cargo problems.

★ ★ ★

Vision to Anticipate the Needs of Tomorrow
Creates New Industries Today

PRESIDENT

EVANS PRODUCTS COMPANY
DETROIT

Evans War Products: Machine Gun Mounts • Tank and Automotive Heating and Ventilating Equipment • Evanoil Water Heaters • Aircraft Engine Mounts • Airplane Landing Gear Beams • Battery Separators • Prefabricated Houses • Plywood • Skyloader • Utility Loader • Auto Loader • Auto-Railer • Auto-Stop • Stampings

Recent Books

• *THE OUTLOOK FOR DOMESTIC AIR TRANSPORT, by Ernest W. Williams, Jr. National Planning Assn., Washington. Paper bound.* 30 *pages,* 25c.

After briefly reviewing the effects of war on the airlines, Williams, economic analyst to the War Production Board, scans prospects for the initial postwar decades and concludes:

1. Because speed is its chief selling point, "air transport is likely to be complementary and supplementary rather than actively competitive with the greater part of the ground transport system. . . . There is every reason to suppose that air transport will create much of its own business. . . The most important and most immediate field for growth is in the passenger side of the business."

2. "Air express and air cargo have been substantially neglected. . . Because of the relatively high costs, air cargo transportation in the near future will probably not be able to make any impression upon the freight traffic of surface carriers. In order to attract even some of the high class less-than-carload and perishable business, it would be necessary to get rates down to 5c. or less per ton-mile. The heavy expense of collection and delivery service would make this impractical. . . . It appears, therefor, that the immediate future of air cargo is in the high class trades which can afford to pay relatively heavy charges, but even this will create a tremendous increase in volume and stimulate a rapid growth of cargo service."

3. "In the not too distant future, wise national policy will quite probably shift the first class mail to the airlines and abolish the surcharge except for expedited special delivery."

4. Possible developments: Northrop Flying Wing—"the design shows from 33 to 50 percent less drag, thus the same speed can be secured with approximately half the horsepower"; The glider—its utility "may be limited to special services such as those in which it is to be dropped off in flight to effect deliveries at one or several intermediate points"; Helicopters—"present designs are so successful as to promise great usefulness after the war, though much additional work is needed to make them ideal for private and commercial use"; Cargo haulage—research on packaging indicates possible weight savings of 33 percent; Engines—"octane ratings of 110 to 115, delivering half again as much power, will very likely be developed, making all existing engines obsolescent."

Among tasks to be tackled, says Williams, are airport planning and feeder systems.

• *FLYING POWER, by C. J. Hylander. The MacMillan Co., New York.* 164 *pages,* $2.

Rudiments of airplane engines—principle, design, ignition, fuel, and lubrication systems—described in simple language and with pertinent drawings by the author.

• *JOE FOSS, FLYING MARINE, as told to Walter Simmons. E. P. Dutton, New York.* 160 *pages, illustrations,* $2.50.

"Old Foss" (27 yr. of age) outlines his aerial career with minute accounts of his 63 days in the Southwest Pacific (mostly Guadalcanal) during which he was credited with knocking down 26 planes. Malaria got him before the Japs.

• *AIRCRAFT PRODUCTION STANDARDS, by Stuart Leavell and Stanley Bungay. McGraw-Hill Book Co., New York.* 264 *pages, illustrations, index,* $2.

Worker's handbook of information considered essential for successful performance of his job. Explained in drawings, specifications, and short passages of text are blueprint reading, materials, inspection, assembly and installation, standard parts, design, and manufacturers' standards.

• *MAKERS OF MODERN STRATEGY, edited by Edward Mead Earle. Princeton University Press, Princeton.* 553 *pages, index,* $3.75.

For students of military theory, this is a goldmine of thought (from Machiavelli to Hitler). There is one essay on air power by Edward P. Warner, CAB vice-chairman and former editor of this magazine.

"The fundamental doctrine" of the air power advocates, Douhet, Mitchell, and Seversky, Warner points out, "is that the airplane possesses such ubiquity and such advantages of speed and elevation, as to possess the power of destroying all surface installations and instruments, ashore or afloat, while itself remaining comparatively safe from any effective reprisal from the ground." Such a situation has not yet arisen in this war, he demonstrates, for two reasons: Air power advocates did not fully appreciate mechanical problems and they underestimated human endurance to bombing.

But the day of air power draws nearer: "Sooner or later, if the process of recurrent trial by world war continues, the development of the implements of aerial warfare and the technique of using them is altogether likely to catch up with the prophets. . . . The pioneer advocates of airpower, and especially Douhet, can be read to greater advantage now than when their books were first published."

• *AERO MECHANIC'S QUESTIONNAIRE, by Ralph P. Rice. Paxon Publications, St. Paul.* 128 *pages,* $3.

Some 2,000 multiple-choice review questions on: The use and maintenance of sheet metal and welding, hydraulics, wood, fabrics and finishes, rigging, aerodynamics, and assembly, CAA regulations, propellers, electrical systems, lubricants, fuels, and power plants.

• *MAXIMUM UTILIZATION OF EMPLOYED MANPOWER. Industrial Relations Section, Princeton University.* 46 *pages,* $1.

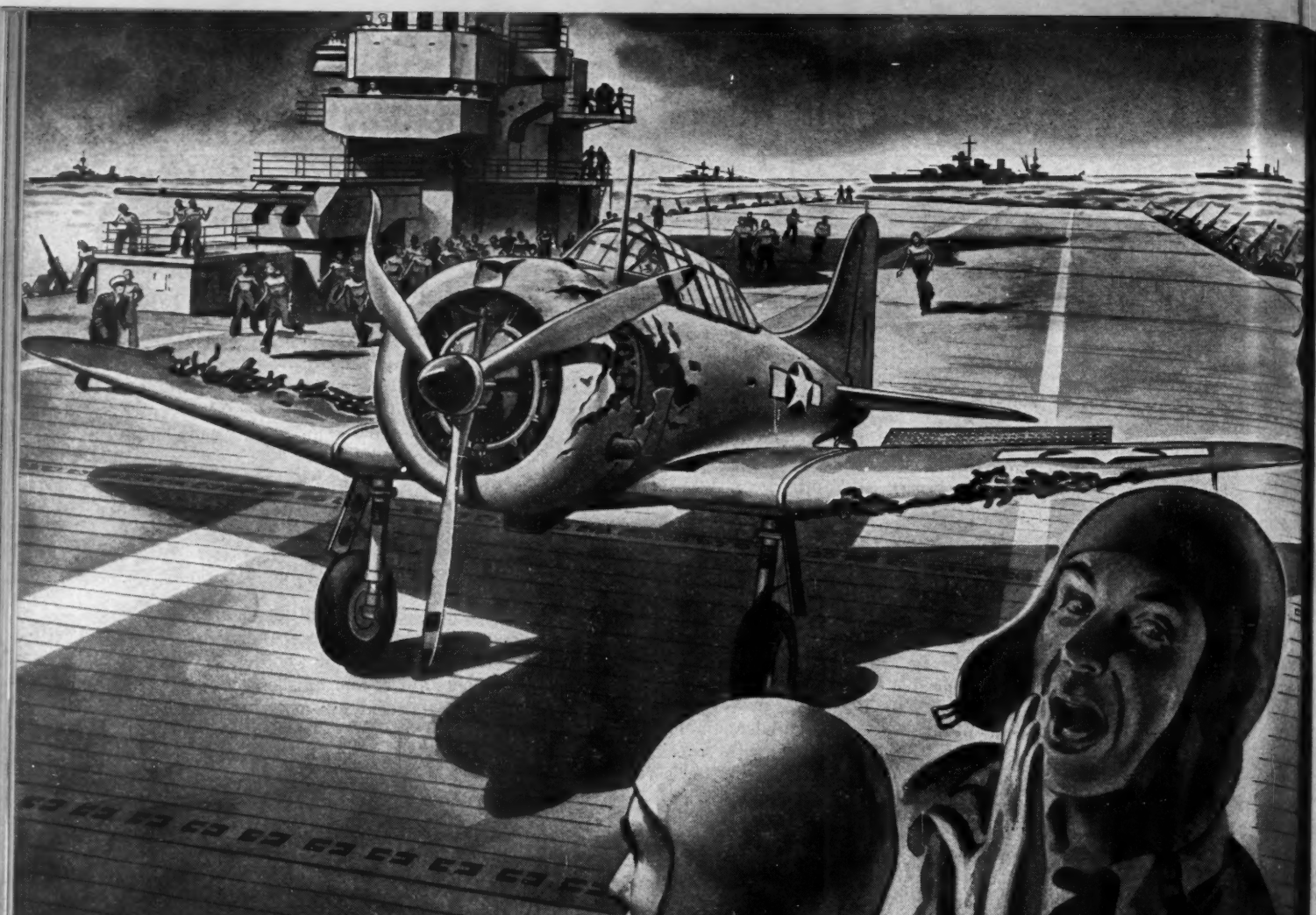
Possibly more than five million man-years in labor potential are going to waste in American factories, "not in the services of new, green labor, but of men and women who are already a part of the experienced personnel of industry," this pamphlet estimates. To aid in uncovering this waste, it outlines various inefficient practices which may be attributed to poor management, instability of work force, ineffective labor management, and situations and conditions which may reduce the workers productiveness.

• *THE HOUSE OF GOODYEAR, by Hugh Allen. Corday & Gross, Cleveland.* 417 *pages, index, illustrations,* $2.

Lauding free enterprise, this book offers a history of the airminded rubber company. The early balloon and dirigible days are particularly well covered. Stressed are management tenets and developments.

• *MANUAL OF AIRCRAFT PRODUCTION, by Bernard H. de Selm. McGraw-Hill Book Co., New York.* 144 *pages, glossary, index,* $1.25.

Descriptions of manufacturing processes to aid workers who want to progress to "the top" where, states the author, "there is a lot of room."



Coming in on a Wing... and Douglas dependability

Operating from a U. S. Aircraft Carrier during the invasion of North Africa, an SBD Dauntless Dive Bomber Pilot flew into a tree while strafing an enemy tank. He damaged the propeller, tore the cowling from one side, ripped the leading edge of the left wing at the root and slashed away the outboard end of the right horizontal stabilizer. In spite of this major damage, the plane returned to the carrier and made a perfect landing. Even as that pilot came in on a wing and Douglas dependability, so United Nations flyers throughout the world are safer while doing greater damage to the enemy because of the ruggedness Douglas men and women build into their planes.

PROGRESS REPORT... The 5,000th SBD Dauntless Dive Bomber will have been produced by the Douglas El Segundo Plant in November. On each of two successive recent months production was 45% ahead of schedule!

Douglas

AIRCRAFT COMPANY

Santa Monica, Calif.

Long Beach El Segundo, and Daggett, Calif., Tulsa, Oklahoma, Oklahoma City, Chicago

Member, Aircraft War Production Council, Inc.

Fixed Base Operator

(*Continued from page 227*)

for sale, the company is securing franchises for distribution of two well known light plane engines, to become effective immediately after the war. Thus, as soon as manufacturers are able to start deliveries, the company will be in the sales and service field covering the complete horsepower range of aircraft engines.

It is significant that Borton and his two associates were originally identified with Thompson Aeronautical Corp. in pioneering mid-western mail and passenger routes and later were with the operations division of American Airlines. From the beginning, nearly ten years ago, the company has concentrated on providing service and maintenance of "airline standards" for the private aircraft owner.

One of General Airmotive's first service contracts was a big one—the job of handling all Cleveland servicing for Central Air Lines, one of the predecessor lines of the present Penn-Central system. This was not the firm's only source of income, however, for it also did both airframe and engine overhauling for individually owned craft. It was during this early period, though, that another of the firm's continued policies was well established. That is, to get the best and most modern equipment possible to be able to do any job that came along. Airmotive had, for example, the first Magnaflux machine in the Cleveland territory. It was largely due to this policy that "Jim Borton's hangar" acquired the reputation of being the National Air Race contestants' service and repair headquarters. The racers knew Borton could do any kind of job—and thoroughly—in time to meet the starter's flag.

This ability to do all manner of work has literally made the firm a subcontractor at various times since the war started; for other general-work operators soon were sending the more difficult and highly specialized tasks to GAC, such as installation of master rod bearings, cam bearings, valve seats, valve guides, spark plug bushings, and other special operations requiring skilled machinists.

Not all the work, however, has been confined to the specialized field, since a conscious effort has always been made to get a fair share of the general maintenance and overhaul work in the area. During the past two years much of this work has come from CPT operators whose equipment has taken the terrific beating that goes with accelerated student training. Even though CPT operators maintain engines, it has been their policy to have accessories serviced at GAC.

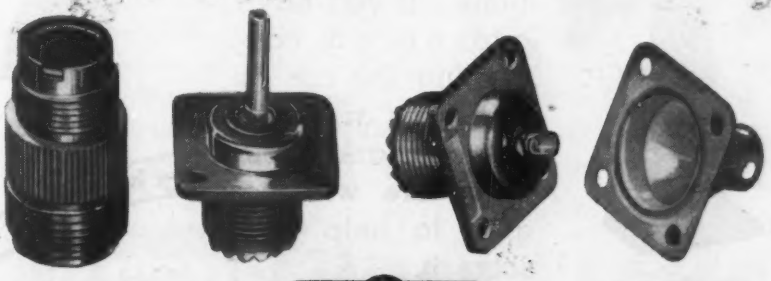
In this connection it should be noted that General Airmotive has never put all its eggs in the flight training basket. In fact, flight training has been only incidental to the other phases of its work. Ground student training, though, has played an important part in its career. GAC's aircraft and engine mechanic school was opened in 1939 with four students. Maximum number ever taken at one time has been 100, for it was early determined that this was the top number that could be handled efficiently. Today the company holds Government certificate No. 92 for its aircraft and engine mechanics' school and is credited with having more than 500 of its graduates and former students in the armed forces, serving in every theater of war.

Some apparently strange—but entirely successful—policies have been maintained in the school. It has never, for example, used solicitors or salesmen to secure students but even so the registrar has from time to time found himself with applicants who couldn't be taken. The only advertising ever utilized has been a small display ad in Sunday editions of one Cleveland paper.

Nor does GAC hesitate to flunk students. Each one gets a daily rating in his log book in addition to periodic examinations. If it becomes apparent that he lacks the aptitude necessary to make a mechanic he is called in for con-

Small Actors Playing IMPORTANT Roles

● In the great drama of war now being enacted before a vast world audience, such small products as radio cable connectors may seem relatively unimportant —yet, upon the efficient functioning of these parts depends the maintenance of vital lines of communications with the fighting units. Astatic Co-axial Cable Connectors, designed and manufactured to meet exacting government standards, are made to take the strain of combat service and provide dependable radio circuit contacts under the most trying conditions. Used and highly praised by many leading radio manufacturers, Astatic Connectors are playing important roles in the field of wartime radio communications. Increased manufacturing facilities insure prompt deliveries.



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THE ASTATIC CORPORATION

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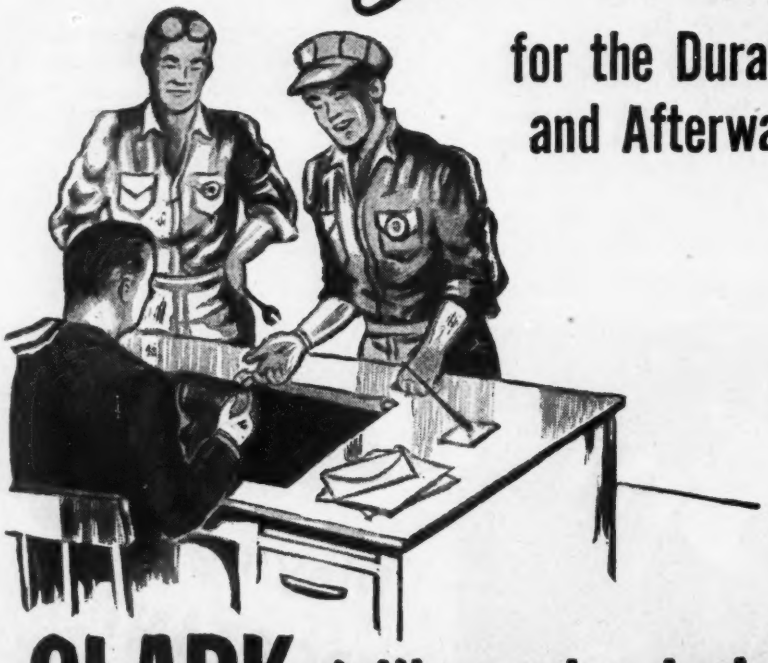
for the Duration and Afterwards



CLARK drills and grinders

Heavy production schedules for the duration and for post-war manufacturing call for drills and grinders that will give maximum service at minimum up-keep and expense. To meet these requirements, Clark has constructed their drills and grinders so, that by actual tests under continuous service, their record of achievement has proved outstanding. In your future plans, include Clark drills and grinders and assure yourself of long service at low cost operations. If you have a problem concerning the use of drills and grinders, call on Clark. Their engineers will be glad to help you solve it.

Buy WAR BONDS

"first in the field" CLARK Electric Tools

JAS. CLARK, JR. ELECTRIC CO.

606 BERGMAN ST., LOUISVILLE, KY.

sultation and given the facts. In the case of a minor, the student's parents are either interviewed or written that it is useless for the boy to continue. One result of this policy has been that 98 per cent of Airmotive's graduates have passed the CAA examinations required for licenses.

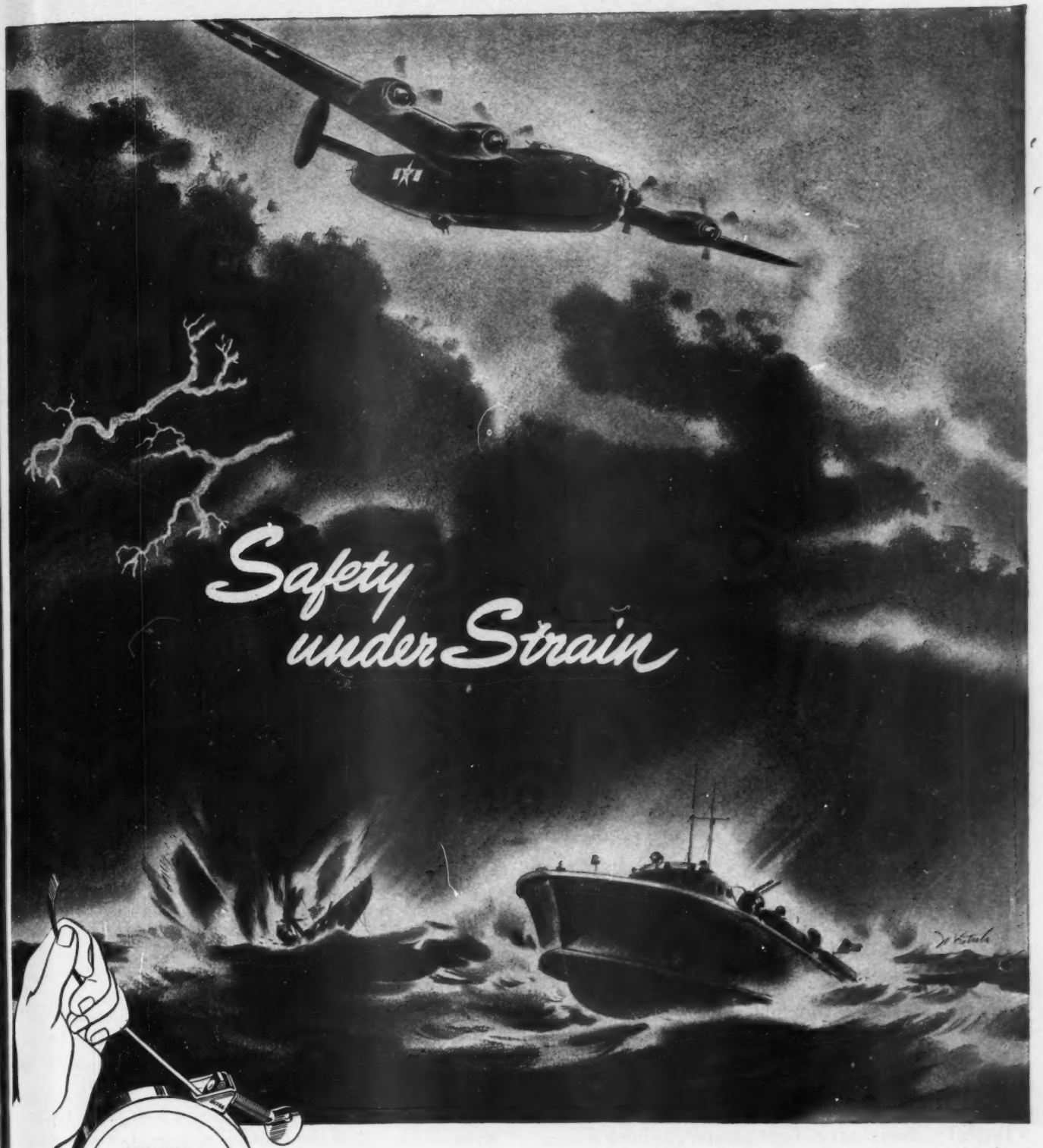
The school—even though it is the sole survivor in the territory—is living proof that such an operation can be profitably conducted despite competition of governmental training courses, paid training for nearby war industries and, of course, the AAF. Oddly enough, many of today's students are men who want to secure their A & E licenses before going into the Army. Four are men, who having seen service and received medical discharges, have returned to complete their courses.

About 20 per cent of the curriculum is devoted to classroom study, while the other 80 per cent consists of practical work on air and liquid cooled engines ranging from 40 to 1,000 hp., and on wood and metal aircraft types in current use. In every case students do work under very close supervision on company-owned planes, engines, and propellers. In one case, the firm purchased a second-hand plane that represented too good a bargain to miss. During the winter months it was thoroughly reconditioned and modified for photographic work. Then it went out on a rental basis in the spring, was gone all summer, and returned late in the fall for complete overhaul during the dull winter flying months. "It was," Borton says, "nice business while it lasted." The craft was in the size group taken over by the government early in the war.

Two rigid rules, both paying rich dividends, have been in force since the organization's inception: First, complete records are required on every job, no matter how small—a common sense business practice that is too often overlooked. Recently, for instance, a case arose in which a propeller threw part of a blade, and the owner remembered having had it straightened some two years ago. Airmotive's records showed exactly what had been done to the blade—so it was possible to complete the case history of the unit in quick order.

Second rule—also a common-sense practice—is to pay cash and take the usual 2 per cent discount on every transaction. "That 2 per cent mounts up over a period of years," Borton told AVIATION's correspondent. "But what's more important, when you pay cash nobody's going to come in and walk out with any of your stock or equipment."

Having successfully weathered the country's worst depression plus two years of wartime operation, General Airmotive's owners look to the postwar era with complete equanimity. They firmly believe there will be a key peacetime



Battle action against the enemy in all weather is the proving ground for ACTUS HOSE CLAMPS. On this small device so much depends. The lives of both battle vehicles and those who man them are secured by the safe "seal-ability" of these clamps. For vital life lines they assure absolute *safety under strain*.

ACTUS ALSO MAKES **WrapLock**
America's Most Efficient "Strip" Hose Clamp
and **WrapLock Hose Clamps**

ACTUS HOSE CLAMPS
AVIATION • • • MARINE

ACTUS PRODUCTS COMPANY • MOUNT VERNON • NEW YORK

Reunion on the Field of Battle

These are Fairchild alumni—fighting men from Norway, Canada, the U. S. A.

Though they come from different parts of the world, these skillful warriors of the United Nations Air Forces have much in common.

Typical of thousands of fliers on every fighting front, each was given an intensive course in a Fairchild Primary Trainer as one important step on the road to winning his wings. Their meeting upon some distant airfield is virtually a reunion of "old grads" of the same Alma Mater.

It is easy to understand why the Air Forces choose Fairchilds for primary training.

There is the element of added safety. For example: quick take-offs and steep climbs can be performed by novices in a Fairchild Trainer without danger of stalling, which caused so many fatalities in the last war. The trainee, behind a 175 or a 200 horsepower Ranger engine, just "pours on the coal" and he's quickly in the air with a lot of runway to spare.

And when it comes to acrobatics, which give a trainee an intimate feel of the controls and teach him instinctive flying, a Fairchild is the answer to an instructor's prayer. No need to crush the student's confidence by telling him not to dive at high speeds. Just teach him all the tricks in the bag, with the full knowledge that safety has been built into every inch of every Fairchild Trainer.

Maneuverability with great safety, and rugged landing characteristics—for which *all* Fairchild trainers are famous—provide the foundation stone of Fairchild's "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland.....Burlington, North Carolina

place for alert fixed base operators, and to this end they are planning some expansion. In addition to taking on two new engines for distribution, the parts and accessories line is to be enlarged, both as to the number of items carried and the stocks to be maintained. Thus the jobber's function will be fulfilled for smaller operators.

Although the school will be retained, emphasis will once more be on sales and service. The school will be continued because it is believed that, although CAA requirements will be changed, skills and licenses will be essential. Expansion of the service end of the business can, and well may, include complete service for feeder lines.

"We expect plenty of competition again after the war," Borton reports, "but we've always been able thus far to get our share of the business. Our policies of being adaptable, getting the best equipment possible, keeping adequate stocks, and doing quality work have kept us well out of the red so far, and we believe these policies will do just as well for us after the war."

Thrust Meter Testing

(*Continued from page* 183)

speed is attained by diving quite sharply, flattening out to an angle only sufficient to maintain the desired speed.

Use of shaft thrust measurements in routine flight testing in order to check calculated airplane performance does not appear very practicable. Additional data whereby corrections can be made are obtained, however, as well as much useful data on propellers, which should lead to improvements in airplane performance. An instrument of this type can also be used to determine relative efficiencies of various propellers more especially in outboard plan form, thickness ratio, pitch distribution, airfoil section, and tip shape.

Another possible use is to determine L/D characteristics of the airplane when gliding at or near zero thrust. Because this type of thrust meter is not adapted to reverse thrust measurements, it would be desirable to make tests with a small, but known, positive thrust. Other uses for an accurate thrust meter will undoubtedly be developed. Therefore it is believed that this rather specialized type of instrument will eventually find a useful place in flight test procedure.

Flexible Cable Control

(*Continued from page* 191)

respect they may be compared favorably to rigid rods in many applications. This result has been achieved by producing a conduit and cable (or other moving

Hydraulic Fittings

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Made Strictly in Accordance with ARMY-NAVY Aeronautical Standards

You can expect the same high standards we have always followed in our production of CONDUIT FITTINGS, 100% inspection by our own skilled staff and always the kind of service that has made so many friends for us among Aircraft Manufacturers.

UNIONAIR

Makers of
Junction Box Assemblies — Hydraulic Fittings
Conduit Fittings — Junction Boxes

UNION AIRCRAFT PRODUCTS CORP., NEW YORK

element) to such close tolerances that "trading" and "snaking" have been substantially eliminated.

Friction remains as a substantial problem and adversely affects the theoretical efficiency. But the friction does not produce unsatisfactory operation in the majority of applications. Flexibility in these controls is almost unlimited, therefore they absorb vibration and relative movement without involuntary operation of the control. They are very light in weight, easy to install, and require little designing on the part of the aircraft manufacturer. Some of these controls do, however, present a problem in field repair and maintenance. They are without exception economical by comparison with the rigid rod and cable types of control.

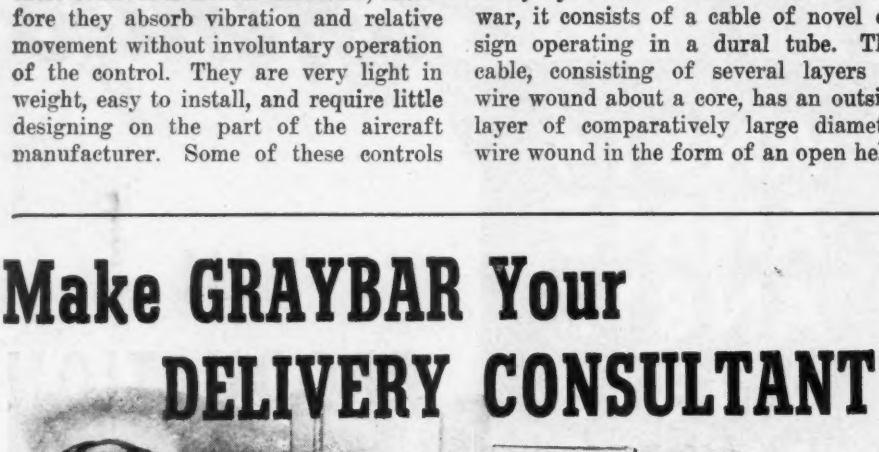
There is an interesting type of flexible control now being manufactured in this country for the first time. Used extensively by the RAF since the outbreak of war, it consists of a cable of novel design operating in a dural tube. This cable, consisting of several layers of wire wound about a core, has an outside layer of comparatively large diameter wire wound in the form of an open helix so that the cable is, in fact, a flexible rack. The helix wire is rounded to form a good bearing surface in contact with the tube through which it moves, thus reducing friction.

The cable itself may be engaged with the teeth of a helical gear, and in this type of application the angular movement is unlimited. The dural tube and the cable are both produced to close tolerances to produce a close fit so that backlash is negligible. Actually, even in lengths of 40 ft. or more, the lost motion is measured in thousandths of an inch. Because of its rugged construction the control is absolutely positive in action under all loads for which it is used, and it is sufficiently flexible to absorb all vibration and relative movement which is encountered in aircraft. It does not operate involuntarily, nor does it require support, except at the control and remote ends. Therefore it transmits no stress to the airframe, except at these two points.

The cable and the tube, which are the dominant parts of the control, may be obtained in bulk, and the control may be formed and installed without any special tools. This simplifies the problems of repair and maintenance of spare parts. Since the cable is not set up under tension, the control requires no attention after installation, except infrequent lubrication. Further, it is very light and because of its small size can readily be installed in any aircraft without special design consideration.

Perhaps the most convincing proof of the satisfactory performance of this control is the fact that it is to be found on the exacting propeller pitch controls of such well known RAF aircraft as the *Mosquito, Lancaster, Typhoon,* and *Spitfire.*

Make GRAYBAR Your DELIVERY CONSULTANT



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• Your local GRAYBAR Representative can relieve you of detail and follow-up on the delivery status of hundreds of different electrical items . . . especially the production items used in the wiring systems of your planes. A single contact "via GRAYBAR" carries through to leading electrical suppliers all over the country. Delivery schedules can be coordinated on all the electrical products that go together in use. For this *specialized* aircraft service, just call GRAYBAR.

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Executive Offices: GRAYBAR BUILDING, NEW YORK 17, N. Y.

How Gunners Learn

(*Continued from page* 225)

That efficiency is evidenced by the fact that Eglin's last class qualified 36 percent of its number as experts (30 percent or more hits); 37 percent as sharpshooters (20 to 30 percent hits); and 16 percent marksmen (15 to 20 percent hits). Only 10 percent failed to qualify. The over-all average of hits for the entire class was 29.1 percent.

In addition to its course for cadets, Eglin conducts a regular school for gunnery instructors. Pilots selected from advanced flying schools take a 15-day course preparing them as gunnery instructors at their original fields, to which they return to direct pre-Eglin gunnery instruction, including "dry runs" with the gunsight aiming point camera and with 10 or 12 hr. in the theory of sighting and aiming.

Principle of the gunsight aiming point

camera, developed at Eglin, is simple. The pilot goes through the same motions he employs on a loaded gun. But here trigger-pressure activates a camera. When developed and projected on a screen, the film shows the student his errors in aim. Another aid conceived at Eglin is the Hale trainer, developed by Maj. J. E. Hale, now assistant A-3 to Eglin's proving ground command. Here, the student first learns to coordinate the activities of both pilot and gunner. "Flying" a Link trainer on which a BB-loaded machine gun is mounted, he lines up his sight on a moving target and pulls the trigger to release a stream of lead pellets at miniature planes in front of him. The Hale trainer, like the aiming camera, today is standard AAF gunnery training equipment.

Flexible Gunnery

The enlisted man who would put the sting in a combat bomber must be a nerveless, healthy fighter who can thrive on the ceaseless noise of battle and the endless tension of lightning-fast action. The plan of flexible gunnery training at Tyndall Field, Fla., is a rigorous one in which the "feel" of actual combat is simulated in numerous ways. The student is placed on edge the day he reports for training. He stuffs cotton in his ears on the gun ranges. The introduction to the deafening roar of powder-explosions temporarily confuses him and mars his aim.

To be accepted for training the applicant must be no more than 5 ft. 10 in. in height and no more than 170 lb. in weight. Excellent vision is requisite.

His first contact with AAF principles of shooting is made on a ground range where he fires .22 cal. bullets at a still target. Instructors tell him how to squeeze the trigger—"just like a lemon"—and how to hold his breath to steady his aim. Later, the embryo gunner uses the same bantam rifle to hurl lead at moving plane models. Thus he learns the knack of leading the target, a fundamental that must become second nature.

Students get the first thrill of automatic fire when they meet the air-powered BB-throwing machine gun on Tyndall's miniature range. The sight and the principles involved in its correct use are identical with those of real-battle guns. Targets are thin metal plane fuselages which move about a continuous track at 400 ft. per min. These targets are scaled to simulate ranges of 200, 400, and 600 yd.

Under the tutelage of nationally famed clay pigeon blasters, gunners-to-be advance from the miniature range to skeet ranges where they get more learning in sighting and leading and are trained for physical and mechanical coordination.

On the moving-base range at Tyndall the gunner first readjusts his technique

Packard Aircraft Electric Cable

Up where the air is thin and cold, the problem of safeguarding the surge of electricity that "sparks" engine performance is intensified many times. It has been one of Packard Electric's assignments to develop ignition cable for high-altitude operation, and this Packard cable is now serving in bombers and fighters of America's air forces. Close cooperation with the air forces, aircraft manufacturers and airlines has enabled Packard Electric to apply the full measure of its experience to meeting the requirements of the aircraft industry. Many types of Packard aircraft electric cable are performing varied functions on airborne equipment.

GUARDIANS OF FREEDOM—
U. S. WAR BONDS

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REG. U. S. PAT. OFF. TRADE MARK
ELECTRIC
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PACKARD CABLE SERVES THE ARMED FORCES
on trucks • jeeps • tanks • armored cars • planes • aircraft instruments • anti-aircraft gun controls • landing boats • radio equipment.

WE'RE COMING OVER

One Corner of the Bell Aircraft Plant

One of the best answers to the prayers of the invaded people of Europe is America's Super Bombers . . raids in which 1000 Super Bombers take part. Raids that increase with ferocity until the very earth rocks beneath Hitler's feet!

To make more certain that those Super Bombers do well the task assigned . . . Bell fighter planes will help give the proper protection.

Thus it is, with pardonable pride, we point to the fact that the Jacoel Cable Splicer . . . newest modern splicing tool . . . is helping in manufacturing Bell Aircraft Control Cables.

JACOEL
CABLE SPLICING EQUIPMENT CO.
1880 Hertel Ave. Buffalo 14, N. Y.

to the demands of apparent motion. From a platform on the back of an Army truck, he shoots at clay pigeons with a .12 gage shotgun while moving 20 mph. around the course of a 1¼ mi. track. Targets are thrown from 25 trap houses along as many different trajectories. Some skin straight up in the air, while a split second later on the other side of the road another will fly out toward the truck. Others head dead-away from the gunner.

The moving base range and many others at Tyndall are supervised by short, sun-tanned Capt. Graydon D. Hubbard, who formerly held four national professional skeet titles—.410, .28, .12, and "high-over-all." Entering the AAF, he completed the six weeks' course at Tyndall and graduated with "expert" honors in every phase.

Students, no longer novices at the art of shotgun-destruction, now progress to the .30 and .50 cal. ground machine gun ranges. Already they are familiar with the innards of the guns, as every off-the-firing-line moment has been spent in tearing down weapons on the tops of tables placed conveniently on each range by Capt. Hubbard.

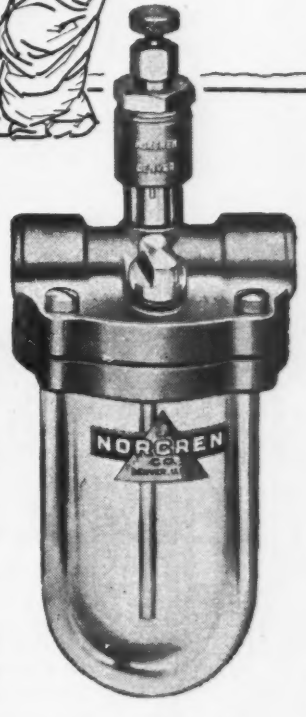
The target on the machine gun ranges is a white, mesh rectangle 11x3 ft. mounted above one of the Army's familiar work horses, the Jeep. The midget target-bearer, concealed from the view of those on the firing line by a protecting earthen embankment, moves at 30 mph. around a continuous single-track. Each student loads his own gun with ammunition tipped with a distinctive color. Thus scores may be totaled by a count of hits of any one color.

Turret Practice

When they progress to Tyndall's shotgun-turrets, students are likely to meet another famous marksman, Capt. Henry B. Joy, lanky skeet range officer who was national amateur all gage skeet champion in 1938 and, in '35, .20 gage title holder and "high-over all" champion for the country. His present skeet gun is a shotgun mounted in a power-operated turret on the back of a stationary truck. Inside the turret, the student sights, triggers, and fires just as he would on a machine gun. The targets are clay pigeons thrown across his field of vision. He learns that turret-shooting permits no personal freedoms in sight alignment. Instead of pointing his body and his gun by physical movement he learns to point a mechanically moved glass-house.

In other classes, students harmonize the line of the bore with that of the sight in order that trajectories of the two will converge at the desired point. On the estimation range, they endeavor to judge the range of planes which fly into their sights at low altitudes and from varying angles of attack.

Never FORGETS!



What is "sweeter" than the brilliant performance of a new air tool . . . in perfect condition?

It packs a wallop! It insures maximum man-hour production . . . with minimum operator fatigue.

With NORGREN LUBRICATION you can *keep* air tool power at new tool peak permanently! Norgren Lubricators are automatic. They start and stop with the air tool. *They never forget!*

CATALOG 400

OILED AIR CHECKS WEAR

Norgren Lubricators inject oil into the air that drives the tool . . . exactly the right amount of oil . . . under positive control. This creates an oil-air fog that maintains a lubricating film over every moving part of the air tool. Checks wear in use. Stops destructive corrosion when idle. Pays back far more than the cost . . . in short order! Size and type for every need. Write to C. A. Norgren Co., Denver.

Norgren

The No. 1 event in the student's career comes when he is okayed by his instructor for his first plane trip on a gunnery mission. He fires flexible guns mounted in the rear cockpits of North American AT-6 advanced trainers, also other weapons which chatter through the sides, tail, tops, and noses of twin-engine and four-engine bombers. The *"Zero"* at which he shoots is a mesh target towed out over the Gulf. Ideas of horizontal lead employed in shooting at clay pigeons must be coupled with the principles of vertical lead necessary to hit a target that may be moving in a downward path beneath him. To sharpen his practical knowledge of ballistics, the student has hours in the classroom. As a further aid in practice, charts showing the vertical lead variables at different ranges are pasted in the gun turrets.

But all of the realistic experiences in school are not found in planes. The developing gunner also encounters the sights and sounds of actual combat in practice rounds in the "Jam Handy" trainer in ground school. In a darkened room, he sits behind a photo-electric-eye machine gun and draws a bead on enemy planes that streak toward him on a motion picture screen. In another trainer, the Waller, he shoots electrical-impulses into a man-made three-dimensional sky that seems to be filled with planes roaring down from every angle.

He studies aircraft identification in class, and when he goes to his barracks he sees plane models suspended from the ceiling over his head and silhouettes tacked on the wall all around him. He eats beneath more models. And in the post exchange they swing from the rafters.

Despite the size of Tyndall's flexible gunnery program, it employs the flight system in which only ten students (a group) are assigned an instructor who works with them throughout their course. With this sufficiency of supervision and equipment (there is one machine gun at Tyndall to each student), unsurpassed efficiency has been developed.

Heading the gunnery school at Tyndall Field is Col. Leland S. Stranatham. Lt. Col. Jack L. Randolph is director of training.

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40% discount off list prices

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By making this 40% discount announcement, the Turner Gauge Grinding Co. has again demonstrated what increased production efficiency together with a modern plant, built for the express purpose of gauge manufacture, can do to lower the cost of gauges.

Let us fill your rush order for standard length steel plug gauges—send in your order today. Remember to include the following information with your order: 1. Diameter. 2. Length of gauging surfaces. 3. Tolerance or accuracy. 4. Hardened alloy steel or chrome. 5. Number of members—Go, Not Go, Handles.

WRITE FOR OUR DELIVERY DATES AND PRICES TODAY!

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Rush deliveries can be made on all Turner's standard plugs,

Upon the receipt of your inquiry (written on your company stationery please) we will forward to you, immediately, complete information and prices on our gauges.

TURNER BROTHERS

TURNER GAUGE GRINDING COMPANY

2627 HILTON ROAD . . . . FERNDALE, MICH.

"Sighted Wreck..."

(*Continued from page* 127)

6. Reconnaissance cars for transporting men from job to job.

7. Truck with 420-gal. water tank for drinking and cooking.

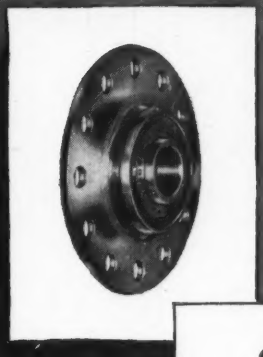
In addition a travelling crane is always available if required (such as in this case when the plane needed lifting to repair its landing gear, bomb doors, and lower ball turret).

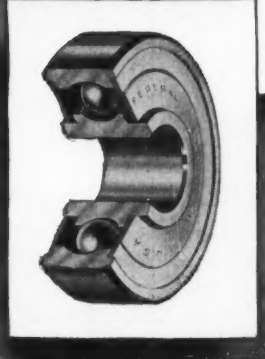
Veteran George Krouskop, LOC civilian in charge of the unit and a man with a nine year background with Boeing and Lockheed, quickly had Tough S—— lifted off her belly so the inspectors could complete their under-fuselage examination. While soldiers and LOC engineers went about their routine jobs, Krouskop discussed the damage inventory with visiting control board officers, and his expert knowledge supplemented the military viewpoint, providing a "fix" for immediate procurement of the urgently needed parts.

The units are so well equipped and so comprehensively stocked that delays due to insufficient tooling and ill-kept stores are rare. Meanwhile, an accurate initial assessment of parts and material needed allows time for them to be rushed to the site while technicians are still stripping damaged parts.

The mobile stores trailer carries its own stock records, and both parts and tools have to be requisitioned in duplicate so that main supply records are kept up to the minute on withdrawals and also so that the service unit, when it returns to its base, can replenish depleted stocks without resorting to a numerical check.

Federal aircraft BEARINGS





For years, FEDERAL AIRCRAFT BEARINGS have been approved and used by leading manufacturers in the aircraft industry.

We have had wide experience in the production of QUALITY ball bearings for aircraft service and with the nation at war, this specialized skill is of vital importance in providing fine control bearings for the air forces of America.

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In at the finish—"MX" WHEELS

. . . AND IT'S THE FINISH THAT'S IMPORTANT!

IN at the finish of innumerable industrial operations these days is the versatile "MX" Wheel, introduced by Carborundum, only a little over a year ago. Their function is to remove "disturbed metal" such as the burrs and tool marks which result from grinding, machining, boring and similar operations.

"MX" Wheels are made up of abrasive grains intermingled with cotton fibres and held together with a suitable binder. They are unlike any other abrasive product made. They are free and clean cutting and are used without coolant. They are resilient and have a cushioning effect which makes them tend to hug the work. Chatter and vibration are reduced. The result is a smooth finish so important in current manufacturing methods.

"MX" Wheels are ideal for breaking corners, removing burrs and polishing grooves and slots. Surrounding surfaces are kept free of abrasive marks. Tolerances are maintained in polishing because of the light stock removal.

Write to Dept. *A*, The Carborundum Company, Niagara Falls, N. Y. for literature describing "MX" Wheels and their many uses.

Every hour this war is shortened will save $12,000,000. The lives it will save are priceless. Let's get it over with—quickly!

ARMY E NAVY

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THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

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(Carborundum and MX are registered trade-marks of and indicate manufacture by The Carborundum Company)

A couple of days after the repair unit got started on Tough S——, officers of the Corps of Engineers arrived and surveyed the site for construction of a temporary runway so that the plane could take the air again as soon as LOC and AAF technicians had completed their job. Following the engineers report, an AAF Engineering Battalion reported to clear the field. It hewed down hedges, leveled the ground, and laid the steel mesh runway—all with mechanical precision.

In no way is the work done by mobile service units makeshift. It is as carefully and accurately carried out as if the plane were being repaired at a main base. Inspection is rigid and frequently cross-checked. Workmanship and ingenuity in making awkward repairs is excellent, meeting a completely professional standard. This shows the wisdom of infiltrating LOC experts among soldier mechanics, many of whom never saw an airplane before entering the armed forces.

After only a very short time, Tough S—— was again in the pink. It was hauled to the temporary runway, where engines were revved up and instruments and flying controls were tested and found okay. Finally all unnecessary equipment was removed (because of the short runway) and Tough S—— took off for her home field where, on arrival, she would be checked over again and test flown before tackling further missions.

Servicing of modern aircraft, with their complex equipment, presents difficult problems even when the operations are in the country of origin. When the planes are transported 4,000 mi. across an ocean and thence disperse over a scattered area for operational purposes, servicing problems become almost impossible if speed, so necessary in this war, is reckoned.

This, then, was Service Command's big problem—a problem which was quickly solved by the mobile service unit, which is now proving so successful that it is being adopted by the RAF. No doubt its use will be extended to other theaters as fast as possible.

The mobile service unit is a young, streamlined idea, both ingenious and practical. It lives up to the highest standards of the AAF for freshness of thought, determination, enthusiasm, and progressiveness.

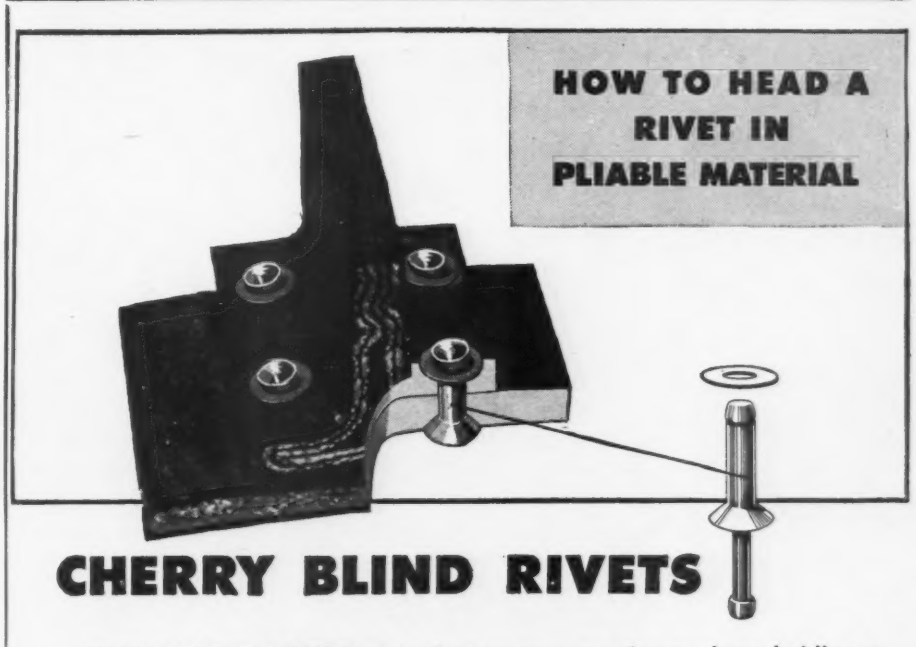
Crew Competition

(*Continued from page* 150)

This system places responsibility right down to the basic crew, and it instills a spirit of competition since no crew wants to have its work found wrong by other crews, flying personnel, or other non-commissioned officers. Stiff penalties, mainly affecting seniority and promotion, are on the books for errors made by crewmen.

New men are placed on trial for a few months. During this time they are putting into practice the theoretical work of the training school. To aid them and also the older maintenance men, sectional parts of all aircraft equipment have been set up in a classroom. This sectional equipment is made at each station from parts of unserviceable aircraft and engines—parts which come from crashes or which have already given all the service required. Engines, for instance, are cut away to show how each part functions, with colored lines drawn to show how the electrical circuits operate and the feed lines function. During off periods, mechanics have their problems solved on this sectionalized equipment.

In addition new men can attend night classes on specialized subjects several times each week. Here they may ask questions and have problems explained. That many mechanics are taking advantage of these methods of learning more about their jobs is noted from the

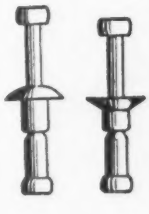


CHERRY BLIND RIVETS

CHERRY BLIND RIVETS of the hollow type are shown above holding a rubber cleat to a rubber conveyor belt. Both hollow and self-plugging types of Cherry Rivets make ideal fasteners for pliable material because they are headed by means of a pulling force. There is no hammering on rivet heads—no bucking bar needed.

Application is faster than with conventional rivets and may be done with inexperienced labor.

There are undoubtedly many places where you too can use Cherry Rivets to save time, reduce costs and get a better job. Ideal for speeding up work on war jobs. Get the complete story on Cherry Rivets now.

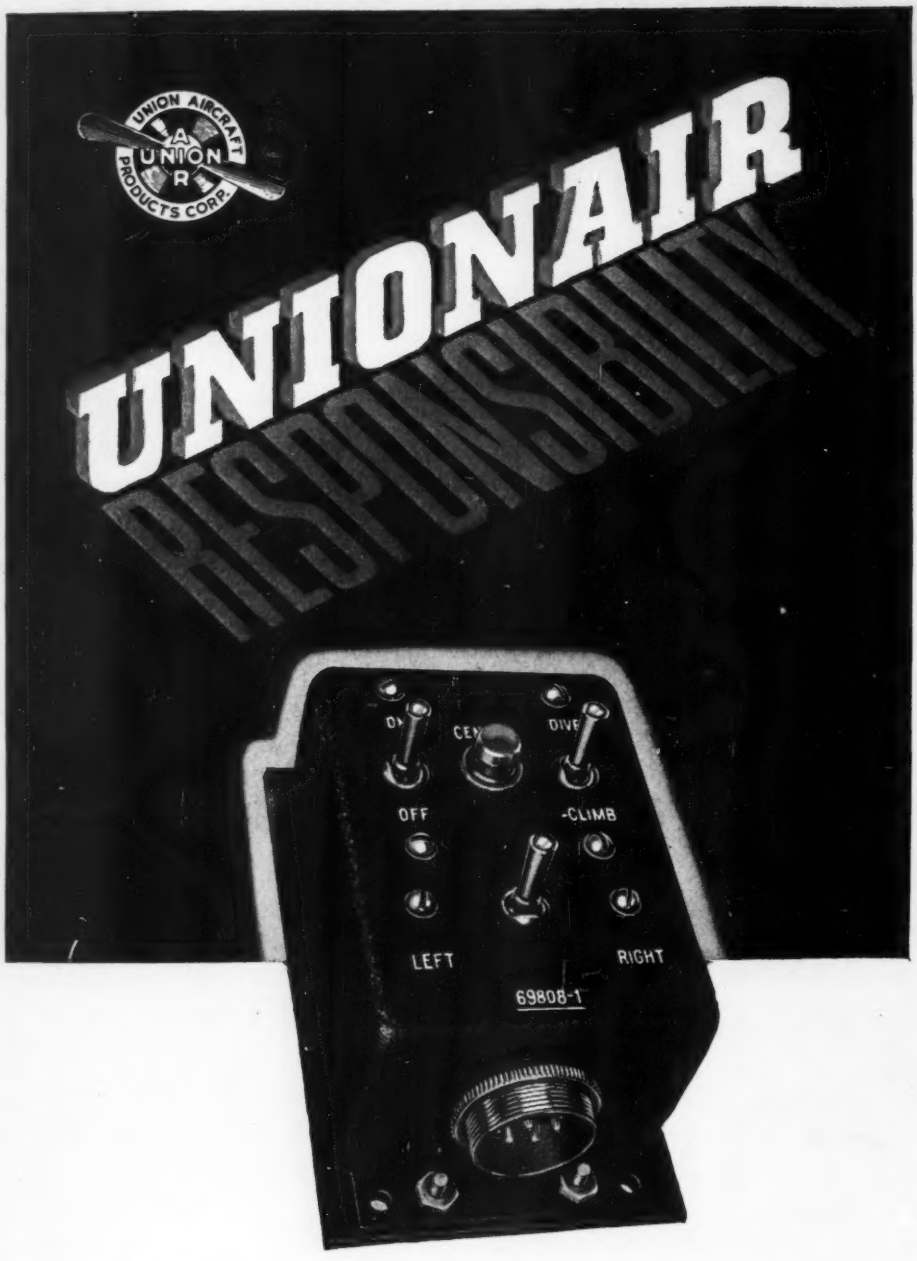


Self-plugging type with brazier and countersunk heads. Mandrel is pulled through rivet and permanently plugs it.

WRITE FOR HANDBOOK telling how to use Cherry Rivets. Address Department A-110, Cherry Rivet Company, 231 Winston St., Los Angeles 13, Calif.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.

Cherry Rivet *Company*
LOS ANGELES, CALIFORNIA



UNIONAIR currently manufactures a full line of JUNCTION BOX ASSEMBLIES for the Aircraft Industry. The unit pictured is a Test Stick Control, completely wired, ready for installation.

The most important single factor that has influenced Aircraft Manufacturers to place these Assemblies with us is UNIONAIR'S insistence on its complete responsibility for their production.

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Makers of
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UNION AIRCRAFT PRODUCTS CORP., NEW YORK

number passing trade tests (which bring more pay) and also from the increased number of serviceable aircraft.

After a mechanic has been on the maintenance staff for a few months and shows promise, he is given a red star on his name card on the board in the control room. If he reaches average ability, the red star is replaced with a blue star. Above average brings a silver star and the chance for a promotion. This is but another feature of the incentive system put into practice at these depots.

The control boards in the hangar control room show not only the work that must be done on each aircraft, when it came in, how long it should be in the hangar, and other standard information, but it also indicates where each man on the maintenance staff is located at any moment. The name cards move with each man's work—from hangar to hangar and job to job. This gives a close check on the full utilization of manpower.

Each station sends in weekly reports on the serviceability of its aircraft and disposal of its strength. From these reports charts are prepared and kept up-to-date showing the state of serviceability of all aircraft. The graphs record the number of aircraft at each station in brown crayon, those potentially serviceable within 48 hr. in blue, and those immediately serviceable in red. If the red and blue lines become too widely divorced at any station, a technical inspector goes to the station, checks up on the reasons for the drop in serviceability percentage, and shows how the system can be improved, according to practical applications developed at other stations.

To aid in keeping aircraft in airworthy condition, a number of practical gadgets have been perfected at RCAF stations. Thus, to save wear and tear on aircraft wings in fueling, a metal step-ladder has been built on gasoline-truck front fenders. By standing on the ladder, the mechanic can fill the training aircraft without stepping on the wing walk.

Carrying a fire extinguisher at a run to a burning aircraft is a difficult job. So the RCAF has devised a wooden-wheeled carrier for the fire extinguisher. It can be trundled to the aircraft at top speed.

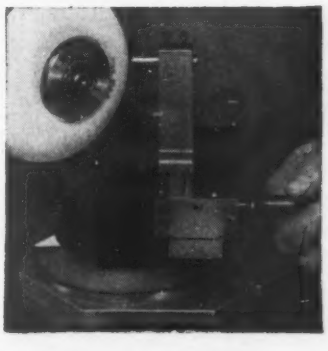
The job of spraying paint and dope used to mean a lot of traveling back and forth to refill the can. Now a box on the portable spraying machine carries two extra five-gallon cans of paint or dope, saving many trips to the store room.

It used to take two men to roll a gasoline can under an aircraft that had to be emptied before overhaul. The same men would also have to carry the can away. Now one man does it on a specially constructed wood and metal truck

Since the VINCO B-1 DRESSER (angle tangent to radius) was designed and its manufacture started, the boss of the Dresser Department, Jimmy Allen, has made it his personal business to see that each and every Dresser was built with VINCO precision throughout.

The demand for this sturdy little Dresser has been increasing—and VINCO has increased manufacturing facilities accordingly. Production has gradually gained until now an adequate stock of Dressers is on hand. This will mean much to those wishing immediate delivery.

But in spite of the increased production, the quality of the Dresser still remains VINCO quality—precision built into every part.



The VINCO B-1 Dresser has almost universal applications; and with the care generally given precision tools, its service, under ordinary production conditions should be long and economical.

Write for the B-1 Folder which contains full details.

VINCO CORPORATION; 8865 SCHAEFER HIGHWAY, DETROIT 27; MICHIGAN

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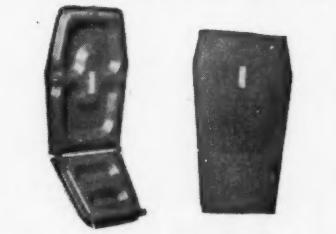
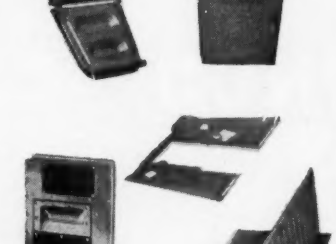
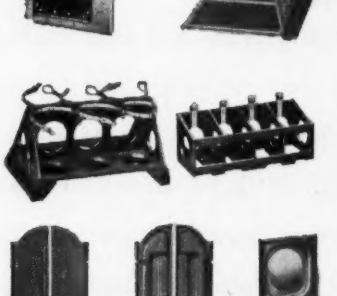
Weber's famed original research and engineering, which produced so many commercial innovations in peacetime, are daily meeting the varied production demands of plane manufacturers. With standards of quality workmanship which go back to 1898 and unexcelled facilities for metal, wood and glass manufacturing, Weber's Aviation Division is ready to serve you.

Our representative will gladly call to discuss your specific needs. Write or wire today!

A FEW OF OUR AIRCRAFT PRODUCTS







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with caster wheels, on which he can easily place the empty drum. A funnel is inserted to catch the gasoline. A metal grounding chain is fastened beneath the low-slung truck.

These are but a few of the "twists" which have been devised by the RCAF to speed up aircraft maintenance and thus keep as high a percentage as possible of serviceable ships at each RCAF station.

"Bush" Maintenance

(*Continued from page* 155)

It must be remembered that at few bases out of which aircraft operate in this area are there suitable hangar facilities to do overhaul or inspection work. In winter most of these bases only have nose hangars for the jobs to be done. Hangars for thorough overhauls are located at Winnipeg and a few other points.

The daily pre-flight inspection is usually completed at these bases at least 15 min. before the aircraft's departure. Engine inspection includes cleaning and check of gas strainers, ignition inspection, removal of side cowlings and inspection for oil leaks, check of exhaust tail pipe, of support brackets, and of batteries. The daily aircraft inspection includes a check on fuel and oil levels, draining fuel tanks at sediment cocks, inspection of propeller hub and blades, cowlings, floats, skis or wheel undercarriage, checking life preservers and belts, and similar details.

This daily inspection covers any aircraft and engine. Similarly the other inspections, as outlined at this division, apply to all makes of aircraft used there, while engine inspections are based on the *Wasp* model. The 25-hr. engine check calls for the daily inspection, plus the removal of all engine cowlings, inspection of engine installation, exhaust manifolds, inter-cylinder baffles, oil radiator control, oil strainer cleaning, carburetor air scoop and control, and thermo-couple connections. The 50-hr. check adds to these the changing of spark plugs, carburetor flushing, inspection of induction manifold for tightness, and checking of all primer lines and connections.

On the 200-hr. engine inspection all the foregoing must be done, and also a thorough check of valve springs and rocker arms, magnetos, checking cylinder base nuts for tightness, draining oil sump, testing electric wiring, checking booster magneto, checking engine controls, removal and inspection of propeller, and washing down entire engine installation.

At these bush bases, aircraft procedure on the 25-hr. check includes a thorough inspection of the entire air-

Continuous, 16-Hour Shift Proves Easy for CURTIS MODEL "C" AIR COMPRESSORS

The Stewart Iron Works, Covington, Kentucky, operates two Curtis Compressors continuously for eight and sixteen-hour shifts against 100-lb. pressure service—supplying air to riveting guns, bulls, furnaces, and pneumatic tools.

Because of the completely satisfactory performance of their first Curtis Model "C" Air Compressor over a period of six years, the Stewart Company installed the second one to handle their increased demand for air.

This is but one example out of many, in which Curtis performance has led to additional installations when extra air was required . . . a tribute to the dependability and economy of Curtis Air Compressors for industrial uses.

Curtis (Timken Bearing Equipped) Compressors Offer:

- Large capacity per dollar of first cost
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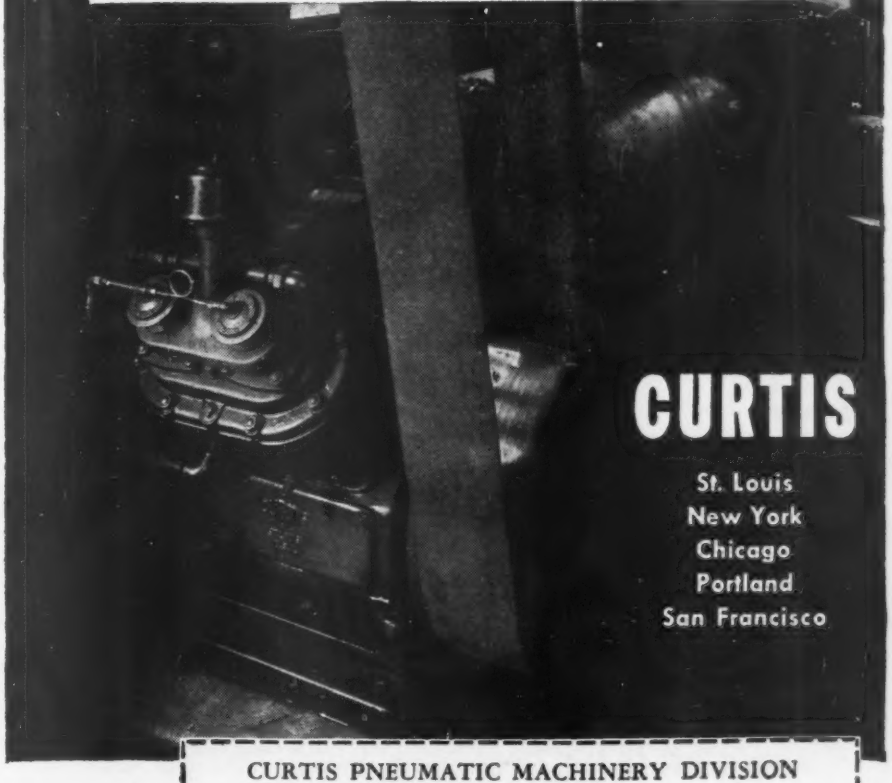
- Low maintenance expense and oil consumption

For full information on the advantages of Curtis Model "C" Air Compressors, send the coupon for details and free booklet, "How Air Is Being Used in Your Industry."



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Please send me your free booklet, "How Air Is Being Used in Your Industry," and further details concerning Curtis Air Hoists.

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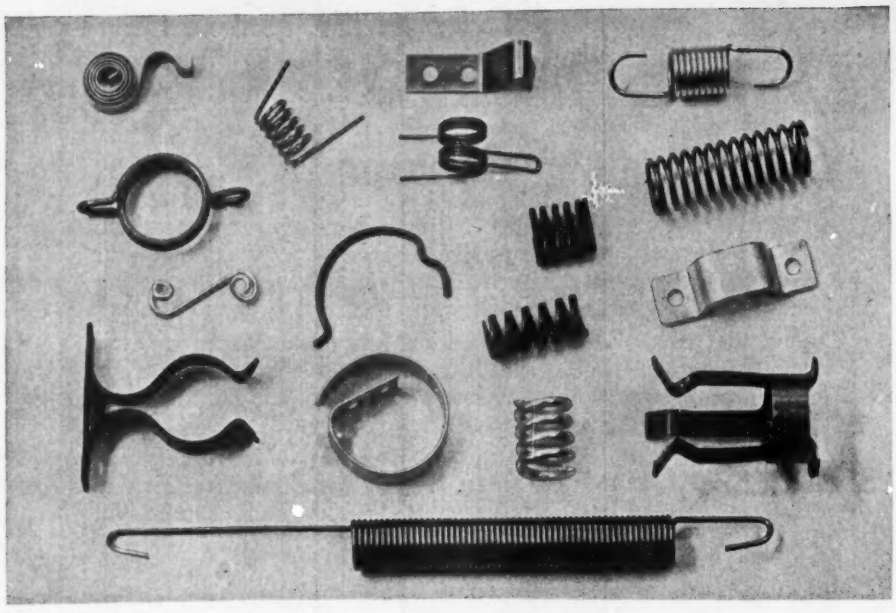

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ROUND AND FLAT WIRE SPRINGS · CLIPS · HOOKS · BENDS · LIGHT STAMPINGS

frame, wings, empennage, emergency exit, controls for excessive play, control column for looseness, and engine ring cowling. On the 50-hr. check, in addition to the above items, all controls must be inspected, including cables and pulleys. The 200-hr. check requires the removal of all inspection plates and a thorough look-over, and repair when needed, of fairings, cabin heaters, tab, flap, stabilizer, and all controls. There is refurbishing of the cabin where necessary.

Loads carried by these bush aircraft include not only mail and passengers but also live cattle, often explosives for mining operations, drilling equipment, engines for mining camps, furniture, fresh food, indeed all types of freight. Wear and tear on cabins of these ships is thus heavier than on commercial passenger lines. And so refurbishing of cabins on the bush lines is an important item, often requiring replacing windows kicked out by live stock.

While this system of north-south air routes has not yet completed two years as a consolidated venture, big strides have been made in developing a standardized maintenance set-up. Manpower troubles due to the war have handicapped the line's maintenance staff. But through another development, CPA sees eventual answer to this shortage—that is, through its current operation of five RCAF overhaul and repair shops. In these five shops, aircraft and engines are overhauled and repaired, largely with a staff which has had to be trained for the work since the start of the war.

Accordingly, CPA expects, in the postwar period, that many of these mechanics, both men and women, will become available for its various operational bases throughout the northland. Further, the shops which have been built as a wartime necessity may then be used for major overhauls.

Metal Show Forecasts

(*Continued from page* 194)

in die castings for ground equipment. In few of these is light weight a factor, but the zinc alloys are applied with high economy. This is not in the realm of new departures, but it is not without significance that the portion of the aircraft industry concerned with ground equipment has rapidly availed itself of the economies of zinc alloy die castings.

Silver continues to expand in aircraft production, though its uses are largely in established forms, chiefly in engine bearings, electrical contacts, and brazing alloys. Indium is still being employed as an electrolytic coating on silver or lead plated silver bearings, but it has found a new use over zinc as applied to steel surfaces, chiefly on hollow steel propellers. The amount

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• LITHOFORM
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• KEMICK
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• FLOSOL
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f indium applied over the zinc is small, eing only 1½ percent of the zinc coat- ng, but the two are heated to fuse them nd form the eutectic zinc-indium alloy. his fusion is said to close all pores in he plated coating and to give it an nusually high resistance to salt-spray nd other corrosion

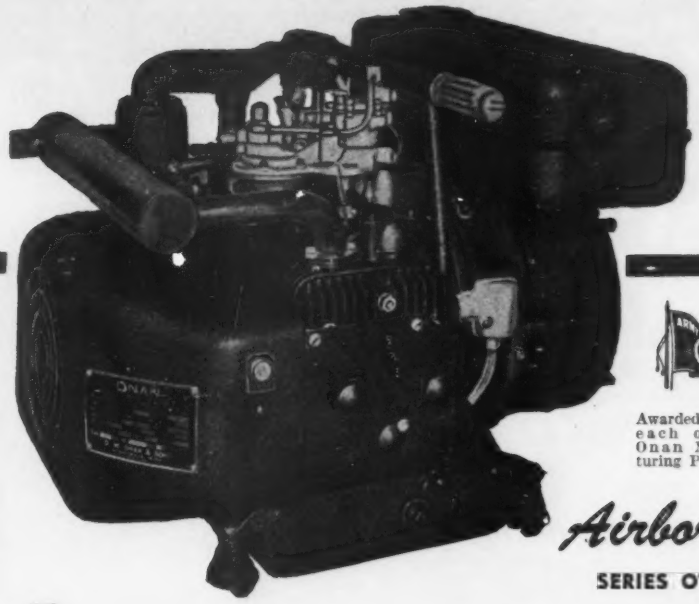
Beryllium appears to be confined argely to use in bronze springs, where s utility is well established There re claims for equal performance for ertain nickel alloys without beryllium, ut the nickel stringency has forced hose particular alloys into the back- round, perhaps for the duration, hough subsequently they may find some ircraft applications.

Among ferrous alloys, however, ickel has been used and presumably ill continue in use to the full extent f its availability. Reports indicate hat the National Emergency steels have ound wide use in aircraft for engine ounts and landing gear parts. For his purpose NE 8630 has replaced AE-X4130 for tubes and other com- onents commonly used in welded struc- ures. Up to the present, very few en- ine parts have been made of NE steels. here relatively large sections are volved, it has been found that NE 740 has proved an inadequate substi- ute for SAE 4140 because it lacks ardenability. For the same reason, no dequate NE substitute has been des- gnated for SAE 4340.

In the field of carburizing steels, none f the NE grades offers core properties omparable with the SAE grades reg- larly employed. Because of the pres- nce of nickel, chrome, and molybdenum n the scrap piles, however, there is a rowing tendency toward adoption of ickel-chrome-molybdenum steels in rder to regulate and control harden- bility.

Some references were heard at the eeting to so-called "liquid forgings," tually castings having properties ore or less duplicating those of forg- gs of the same or similar composition ome such forgings are centrifugally st (see Ford's Centrifugal Cast Cyl- nders, page 134, June AVIATION) and re produced under exacting control. o what extent such castings can be bstituted for forgings in aircraft ork is uncertain as yet, but there are ossibilities even for crankshafts for gines for moderate power, possibly n SAE 4330 steel. In days when even nalloyed gray iron castings having a nsile strength of 80,000 psi. or higher re produced, it is hard to say what ay be accomplished with alloy iron or eel castings.

Nickel iron castings produced in sand re already being used for aircraft gine cylinders. Some receive a crewed-on aluminum head, but others re employed as inserts in making alu-



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minum castings, the aluminum forming the cylinder head and the fins along the barrel or liner. An actual bond is said to be formed between the nickel alloy iron and the aluminum and, despite some difference in expansion between the two metals, satisfactory heat transfer from the cylinder liner to the aluminum is said to be realized.

It is possible that still better results may be secured if conditions should permit the use of an alloy iron, such as Ni-Resist (containing 15-17 percent nickel, 5-7 percent copper, and 2-3 percent chromium) which has nearly the same coefficient of expansion as aluminum.

Stainless steels continue to find considerable use, especially where high strength, light weight, and high corrosion resistance are required. According to some authorities, however, types low in nickel content have proved equally satisfactory (in exhaust line parts) as the 18-8 type formerly favored. In certain cases, welded tube is now used where only seamless was permitted before. Some of this tubing is drawn to size after welding. This works the weld, improving its structure or causing it to split if a weak weld has been made. One tubing manufacturer reports, however, that welded tubing is not gaining the acceptance some had anticipated as a substitute for the seamless type.

Although some structural parts are made from stainless steel, the types high in nickel are not favored because of the nickel scarcity. But, as stainless steel is now produced in large quantities and very thin gages which are likely to be continued after the war, there is a revival of talk concerning possible postwar uses for skin and other structural applications made from such metals, especially as the proposed assemblies probably can be successfully spotwelded. This presupposes a satisfactory structure and one at least as light and as low in cost as an equivalent aluminum structure.

On the other side of the picture is the increased availability of aluminum, presumably to be at the "lowest prices ever" in the postwar economy, and the improved technique for spot-welding aluminum alloys, including the newer and stronger types. Should such structures prove to be producible in adequate strength and reliability and perhaps be stiffer for equal weight and strength than the stainless steel type, the latter might lose whatever advantage its sponsors anticipate. One aircraft manufacturer is reported using the 17-7 type of stainless steel effectively. This steel is capable of developing 200,000 psi. tensile strength with relatively high ductility.

At least one company is understood to have developed an 18-8 type of stainless

steel capable of precipitation hardening. This type, according to one metallurgist, can be hardened after fabrication to a tensile strength of about 200,000 psi. This is urged as a point favoring use in aircraft structures. If the claim is valid, its effect and that of other factors will probably be difficult to establish until applied to a specific construction problem.

There were, of course, numerous other developments mentioned or displayed during the Chicago meeting which may prove significant to the aircraft industry. The developments described here, though merely typical, suggest that new horizons are appearing in the metals field and that the postwar aircraft industry will not be lacking for new materials well adapted to its need.

Sub Killers

(*Continued from page* 135)

and a huge net, 220 ft. long and 200 ft. wide, is spread over the inflated bag.

With the net secured, the car is then detached from the bag and wheeled away in a giant cradle. Sand bags, previously hung around the edges of the net, are gradually raised, diamond by diamond, on the net to force the bag down to the deck. The deflation lines are hooked up to the ship, and the helium is removed to storage in huge Horton spheres.

As the ship is deflated, the 550 sandbags are moved up the net, holding the partially deflated bag down. Finally, after several hours, the ship is completely deflated. The envelope must then be partially inflated with air so that riggers can go inside and remove valves.

The helium plant necessary to handle erection, deflation, and purging of K-type airships consists of four stage compressors, operating at 2,400 lb. per square inch and a purification column at −192 deg. C. The purification rate of the plant is 12,000 cu.ft.-hr. Storage of helium is in two banks of cylinders, each consisting of 85 units of 2 ft.-dia. and 80 ft. long. Pressure in this stowage is 750 lb. per square inch, with a total capacity of 2,000,000 cu. ft.

Supply of helium is received at the station either by special railroad cars or high speed tractor trailers, and it is immediately placed in medium pressure storage. An underground piping system is connected to all three hangars, and by use of Worthington compressors, ships are deflated at the rate of 48,000 cu.ft.hr. This impure helium is then transferred to one of two Horton spheres with a capacity of 480,000 cu.ft. at 60 lb. pressure. When these spheres are filled, the plant is started, and the accumulated gas is then purified and transferred to storage.

As the helium in the ships loses purity, it becomes necessary either to add pure helium or to purge the ships in order to attain maximum lift. This is accomplished by drawing the impure helium out of the low part of the envelope and replacing it at the same rate so that proper pressure is maintained. The impure helium is accumulated in the spheres and purified when capacity is reached.

For advanced bases, a portable purification unit has been developed by du Pont, using a continuous circulation and charcoal purification. The rate of 4,000 cu.ft.-hr. is relatively slow, but if it is augmented by stowage, a sufficient supply can be built up to keep proper purities.

Once the car is secured the real work begins. The 24 slender wood nose battens are relaced on the nose and the nose spindle is installed. Electricians re-install all leads for running and avigational lights and electrical instruments, and radio men install the two receivers and two transmitters and intercommunication equipment. Instrument men connect all the flight instruments, while mechanics install new engines and accessories. Other riggers are busy installing the horizontal and

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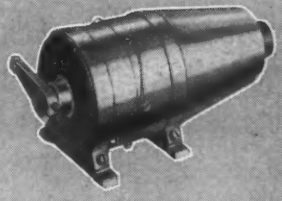

THE usual arrangement employs a Control Motor on a butterfly valve in the outlet of a heater unit. The position of this valve is controlled from a Thermostat which automatically proportions the heat supply to maintain uniform cabin temperature. A Duplex Thermostat is available when simultaneous control of parallel systems is desired. If the airplane has intercoolers and aftercoolers, heat from these may also be valved to the cabin by Control Motors. A Limit Thermostat in the duct is often used to prevent excessive temperature in the heat distribution system. Barber-Colman Cabin Temperature Control Systems are adaptable to all types of bombers, transport, cargo and commercial passenger aircraft and have successfully demonstrated accurate and reliable service at any altitude. Write for detailed information.

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vertical tail surfaces and adjusting the many fin brace wires to their proper tensions.

At last the ship, completely reassembled and ready for 3,000 hr. more of flying, is in line for dock trials and test flight.

Behind the schedule of these routine overhauls is a story of teamwork and industry. Sailors and civilians working side by side have made rigorous schedules routine. No less than 20 shops have handled this part of the overhaul, and all have had a heretofore impossible schedule to meet. Working together are these shops: Battery, cable, engine change, fabric, instrument, machine, metal, special equipment, dope, paint, sand blast, plating, propeller, electric, Lawrance, CO_2, and riggers, together with the parachute loft, and the helium plant, manned by over 200 enlisted men and 100 civilians.

Besides these shops, various offices—planning and estimating, engineering, overhaul, production, inspection, safety, and personnel—have all contributed their efforts and skill to the completed ship.

Moreover, the workers in the drafting and blueprint section have added their efforts to effect changes and improvements, and a Goodyear field engineer has assisted with his knowledge and manufacturing experience in K-ships.

The work that shops, offices, and departments have accomplished in a major overhaul is divided into routine renovation, adjustment and replacement, and service changes. The latter are technical improvements or refinements in present equipment for more efficient operation and occasionally for removal of equipment not considered necessary when the weight involved is too great. These service changes, approved by the Bureau of Aeronautics, are serially numbered. Bureau changes usually are the result of RUDM's (Report of Unsatisfactory or Defective Material) which are submitted by squadrons, hedrons, or air stations.

Air stations are permitted to make local changes. These changes are circulated with descriptions and blue print to all L.T.A. activities, and adoption of them is optional. If the local changes are accepted as service changes, they become mandatory and A & R accomplishes them the next time the ship has hangar availability.

Manufacturing, which accounts for about 30 percent of A & R's work load, is a varied and specialized process. With shop equipment still far from complete and most material to be used requiring high priority, the mechanical processes are only half the battle. Job orders for one day often include manufacturing canvas bags for sand ballast, plating canteens for Marine landing forces, making homing loops for R.D.F. sets, special clips for auxiliary brace wires, fittings for masts, an improvised bomb sight, and other widely varied items.

An improvised plating process using batteries as a source of current and two blow torches for heat has made cadmium and chrome plating and anodizing possible.

When proper ladders for work on the sides of the ships and the lower fins could not be purchased, the carpenter shop undertook the task of manufacturing 20 55-ft. ladders for new bases. While carpenters made the actual ladders, the bases were shaped by metalsmiths, and salvage automobile wheels were mounted to give the necessary mobility. The units were completed for 50 percent of the expected cost and much quicker than they would have been available had they been purchased outside.

Richmond's organization is headed by an A & R officer, with an assistant in charge of administrative affairs. A production superintendent heads up all work, with sub-divisions under him handled by an overhaul superintendent and an assistant, a shop superintendent,

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and a helium officer in charge of the helium plant. The finances and budgeting, as well as the necessary purchasing and planning, are under a planning and estimating officer. A maintenance officer and his assistant have charge of maintenance of the hangar, together with all of the shop equipment. Both civilian and enlisted personnel matters are managed by a personnel officer. Safety measures for all processes and personnel are administered by a safety officer.

Personnel at present numbers about 300. Of these, 200 are sailors and 100 civilians. Women are used extensively due to the manpower shortage. They have been found exceptionally capable in fabric and cable work. Almost all office work is handled by Civil Service women personnel.

The thirteen months just passed have seen a tremendous growth and a great deal of work done under trying conditions.

True, the next year will not be easy, but with equipment and material becoming available—plus the "can do" spirit—A & R can be depended upon to "keep 'em flying".

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Cruise Control

(*Continued from page* 217)

To obtain zone times when using this type of chart, the true airspeed must be calculated, using a computer or a cruising power chart in order to determine true airspeed from instrument airspeed. The effective wind is then added or subtracted, as the case may be, to obtain ground speed. The procedure for using the maximum range chart is explained by the example on the chart.

Several types of computers of time, speed, and fuel consumption are in use. Generally, they are basically of the circular slide rule type, and to be used directly in flight planning they must be supplemented by speed-power charts for the particular airplane.

Since the weight available for payload depends upon the fuel carried, other factors constant, it is imperative that the operation of pre-determining fuel required be very accurately carried out in order that the flight may be completed safely, still leaving the maximum weight available for payload.

During the descent, it is customary to have the same cruising power on the engines, allowing the airspeed to increase during the descent. Thus the time to reach the airport is decreased. On the other hand, it is usually necessary to do some air maneuvering—circling the field to get lined up on the landing runway, which requires some extra time.

As a general rule, the extra time required in airport maneuvering is offset by the time gained through faster airspeed in the descent. Since mixtures are richened during the last part of the descent, preparing for the landing, fuel consumption in gallons per hour stays very nearly constant, even when power is reduced during the last part of the airport maneuvers.

Thus fuel and time are computed as if the cruising altitude were held right to the airport, then an instantaneous landing made, there being no allowance for the descent.

The subject of fuel reserve is a complete study in itself, and will be but briefly treated: First requirement in computing a fuel reserve is to determine the fuel and time requirements to reach some alternate airport at which the weather will undoubtedly be good for landing, should the original destination be closed in because of bad weather.

The fuel required to reach the alternate is computed from the usual cruising chart as if it were one leg or zone of the flight. In addition to reaching the alternate airport, it may be necessary to spend some time at the alternate with an air traffic delay and making an instrument approach. Usually

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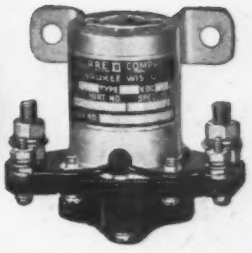
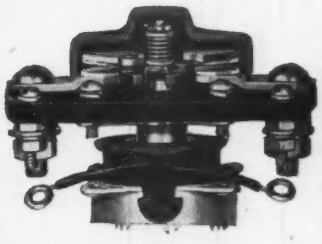


100 ampere, single pole, non-reversing contactor, Class 9350, Type B-6A.



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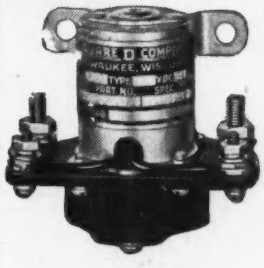
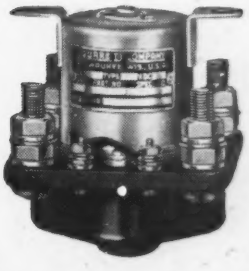
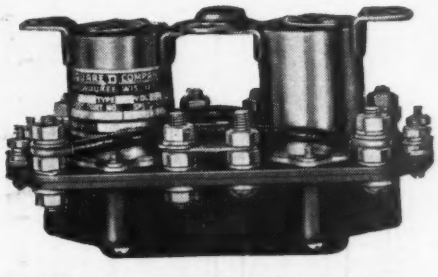


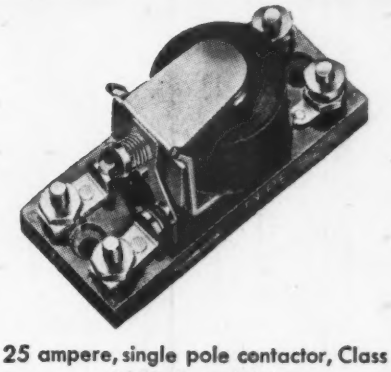
50 ampere, single pole, non-reversing contactor, Class 9350, Type B-5A.



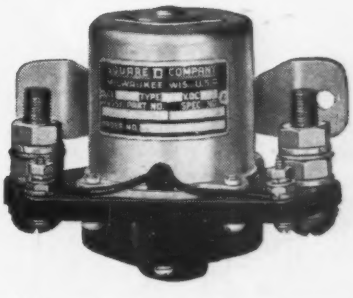
200 ampere, double pole, non-reversing contactor, Class 9350, Type K-3.



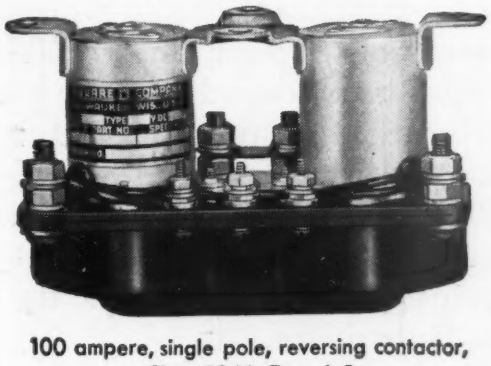
100 ampere, double pole, reversing contactor, Class 9360, Type C-2.



25 ampere, single pole contactor, Class 9350, Type B-2A.



200 ampere, single pole, non-reversing contactor, Class 9350, Type B-4.



100 ampere, single pole, reversing contactor, Class 9360, Type L-2.

• Square D aircraft contactors of all sizes and types, afford dependable performance in any mounting position, under these conditions: Acceleration of 10 G's. Vibration up to 55 c.p.s. at 1/16" excursion. Altitudes up to 40,000 feet. Temperatures from −65° F to +160° F. Light weight, simplicity of design, and ease of inspection and maintenance are outstanding features.

In addition to contactors, Square D's broad aircraft line includes circuit breakers, snap action push buttons, inverter relays and many other special purpose devices. Write for illustrated bulletins.

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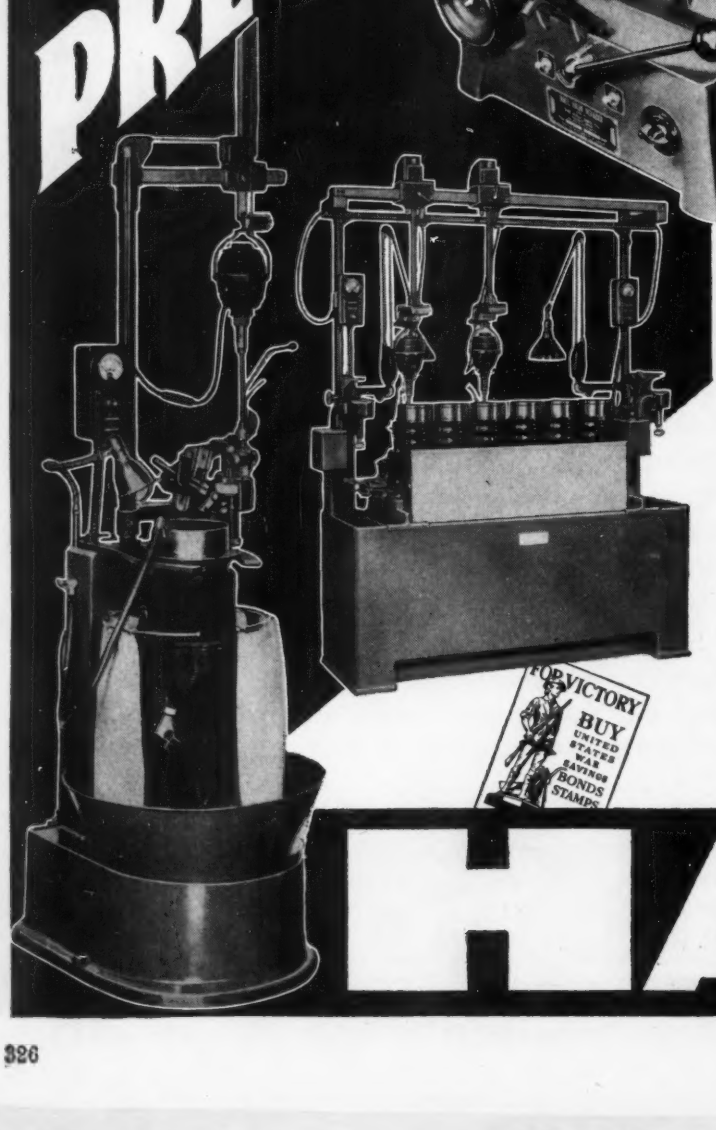
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

WHY SACRIFICE SPEED TO GET PRECISION?



some flat period of time is allowed for this, depending on the airport. One hour is often an adequate time allowance.

On long over-water flights, where weather conditions and winds are not too well known and where avigational facilities such as frequent radio fixes are missing, there is sometimes added a constant fuel allowance per 1,000 mi. This might be 45 min. of cruising power per 1,000 mi. This makes allowances for getting blown off course while on instruments with no means of checking, more unfavorable winds than forecast, etc.

The last allowance usually made is for the minimum amount of fuel in the tanks with which all four engines will continue to run. When a tank is run completely dry, the engines run erratically for the last few gallons especially in rough air. Thus there is a minimum amount of fuel in the tanks with which all engines will run smoothly in very rough air. A flight plan should include the minimum fuel as a constant requirement.

To summarize: In computing the time and fuel for any trip, requirements must be determined for warm-up, run-up, taxiing, another run-up, takeoff, climb, cruising to destination, descent, extra fuel allowances for unpredictable winds and weather, cruising to an alternate airport, and spending time getting into that airport with enough fuel in the bottom of the tanks to keep all engines running until the airplane is finally on the ground.

Not all of the above factors are required for all flights. Those which apply should be allowed for. Determining an adequate, but not excessive, fuel load is one of the most important duties of a pilot or avigator. Too much care in this matter is impossible.

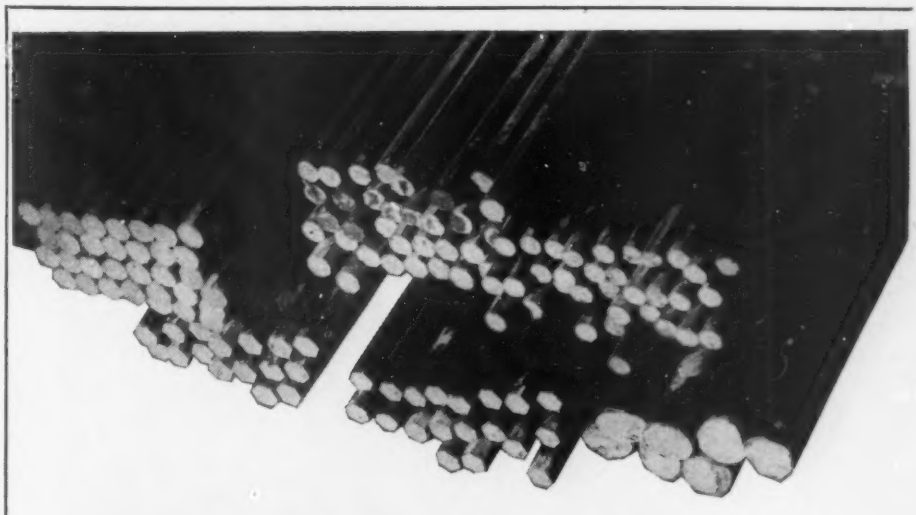
Mfg. & Mt. Join Hands

(*Continued from page* 123)

experienced some difficulty with our equipment, a man was dispatched from the home plant to assist in overcoming the trouble. However the picture has considerably changed since that time, and due in part to the increasing number and types of airplanes, coupled with the fact that training of maintenance personnel by the armed forces has thus far been unable to meet their requirements, it is an inescapable fact that the burden of keeping airplanes in service must depend to a great extent upon the manufacturer's ability to furnish trained field service men to assist operating organizations wherever the need arises.

To provide this assistance when it is needed most, we have divided the country into various zones, each composed of several states in which are located the greatest centers of operational activity. To each zone is assigned a supervising representative who coordinates the activities of a number of field representatives and who knows at all times the exact location of each one of them. Each supervising representative is in constant touch with his home plant so that upon receipt of an urgent request from Army, Navy, or commercial operators for assistance anywhere in his particular zone, it is only necessary to get in touch with the senior representative, who in turn dispatches the nearest specialist to the scene of the trouble. In this manner, we have been able to provide material assistance in the field on a 24-hr. basis.

To these field service men must go much of credit not only for the assistance they provide operators in the field but also for the service and maintenance data which they have acquired, under actual operating conditions, for incorporation in the maintenance and repair publications mentioned previously. For example, the light bomber repair manual would hardly have been possible were it not for the reports received from our



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Aircraft quality 8630, X4130 and 4140 alloy steel bars—hot rolled, cold finished and heat treated—in a wide range of sizes—are carried in stock for immediate shipment from Ryerson plants at Chicago, St. Louis, Cincinnati and Jersey City. These steels conform to specifications: AN-S-14, AN-QQ-S-684, and AN-QQ-S-752 respectively and are readily available to aircraft manufacturers and their subcontractors under the ACW program. A special booklet of stocks on hand, "Aircraft Alloy Steels," will be sent to you on request.

Other steels at ten Ryerson plants comprise over 10,000 different kinds, shapes and sizes—everything in steel. Call your nearby Ryerson plant first—for quick action on steel. Joseph T. Ryerson & Son, Inc., Steel-Service Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON
STEEL-SERVICE

men in the combat areas regarding the conditions under which our airplanes were being operated and the reports on types of damage most frequently encountered.

From the ice-covered landing fields of the Aleutians to the hot and sandy deserts of Libya, our field service men have been in the vanguard of those units arriving in combat areas equipped with Douglas airplanes. In recent weeks we have received the first reports from these men who accompanied the Allied Air Forces from Sicily to the invasion bridgeheads of Italy and who are now lending invaluable assistance in the maintenance and operation of our airplanes from the landing strips so recently taken from the enemy.

Although separate service departments are maintained in each of our plants to handle the problems arising in connection with the operation and maintenance of the particular type airplane manufactured there, these divisional service departments are all coordinated through the service manager at the Santa Monica plant. Similarly, the field service representatives for all plants are handled through our Santa Monica branch. In this way, it is felt that the greatest degree of coordination between all branches and groups may be attained, and that service to the customer will thereby be greatly enhanced.

One of the projects administered by our service personnel serves to emphasize the new scientific approach to service problems, and it will also prove of real aid in decreased maintenance and operating costs. This project involves compilation of overhaul and maintenance data received from operators—a compilation to assist these operators in obtaining overhaul and inspection extension periods for all the component parts of the airplane in accordance with Article 3 of CAA Safety Regulation Release No. 135.

As a concrete example of this service, we recently approved extension of overhaul periods on various component parts of the DC-3 type plane from 100 hr. up to 1,000 hr. per unit. Outer wings which were formerly removed every 4,000 hr. have received approval to remain in service 5,000 hr. before being removed. This one example, multiplied by the large number of airplanes now being operated and the large number of units on which overhaul extensions could be obtained, points the way towards decreased maintenance costs and greater operating efficiency.

In conclusion, we believe that present day service organizations, having already proved their essential character to the industry, must, if the goals and problems of postwar aviation are to be successfully met and overcome in the future, continually search after more scientific methods of approach to the varied problems coincident with the vastly increased number of aircraft in service.

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USING SKILSAW TOOLS
It's no wonder that Timm Aircraft Corp. depends on SKILSAW ZEPHYRPLANES for surfacing its famous plywood trainers. This 3-IN. BELT SANDER is perfectly balanced to produce the satin-smooth finish necessary on every inch of wing, tail and fuselage. It's powerful and ruggedly built to provide peak output and long trouble-free operation. Yet, SKILSAW ZEPHYRPLANE is light and compact for easy day-long handling even by women workers.
Ask your distributor to demonstrate SKILSAW ZEPHYRPLANE on your surfacing jobs . . . on wood, metals, plastics or compositions. See for yourself how much it saves—in time, money and manpower! Phone your distributor now!
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SKILSAW PORTABLE ELECTRIC TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE

Helicopter's Future

(*Continued from page* 117)

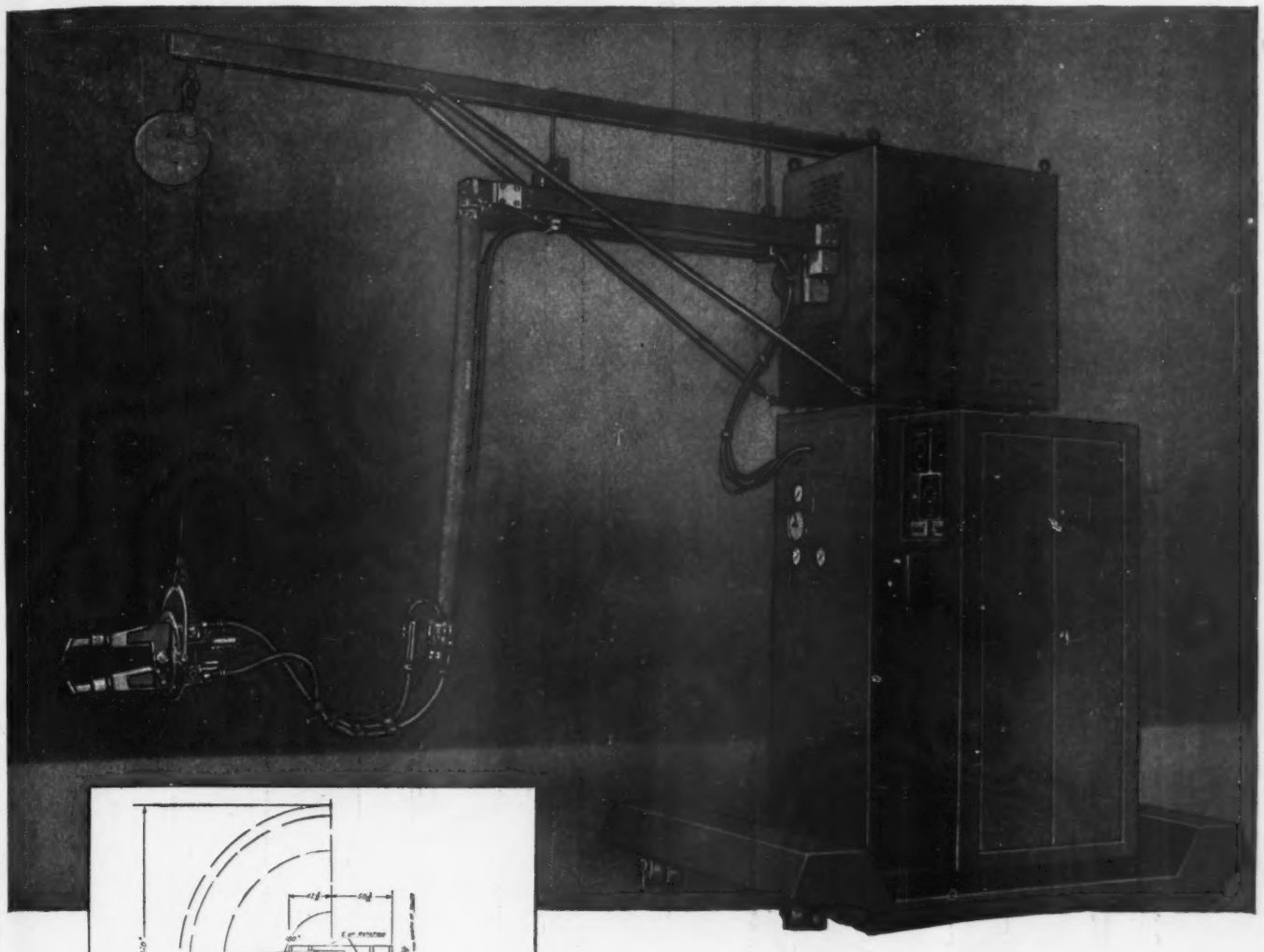
ess of development and construction are but "symbols" of what the public really wants or should have.

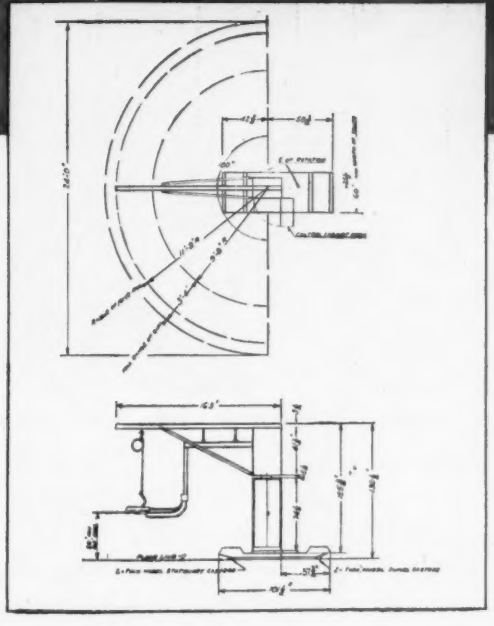
Yes, a great deal of ballyhoo surrounding the helicopter publicity is wishful thinking. It is important that the public is not oversold on this form of flying, since this might retard the ground work of the industry just as public enthusiasm for the autogyro hurt that development some years ago.

Too many of the engineering factors essential to making a commercial product are being glossed over or not too purely considered. To make a helicopter "fly" is as simple as assembling an engine on four wheels with a gear drive to simulate an automobile. But, it must be more than a machine that rises off the ground if it is to meet with the dream of the public as a safe family machine.

We who have lived with the problems

HELPING TO SOLVE TODAY'S WARTIME PRODUCTION PROBLEMS





Dimension drawing of Sciaky Type PS2R-1, 100 KW, Radial Portable Spot Welder, showing maximum reach of gun and 180° rotation. Capacity: Aluminum and light alloys in two thicknesses of .016" minimum up to and including .064"—corrosion resisting steels up to two thicknesses of .080".

it reaches your welding problems

This radial portable spot welder for aluminum and light alloys will fill a long felt need in the fabrication of light structures. Sciaky engineering now makes it possible to bring the advantages of aluminum spot welding *to the assembly.* Crowded and fixed jigs can be easily reached. Tacking operations as well as structural welding can be accomplished with greater speed and efficiency.

Stored Energy with Preheating and Variable Pressure, features which are established as superior in the welding of aluminum, are employed. The control cabinet, main welding reactor, monorail and special copper bars connecting the gun to cables are all built as a self contained unit. This unit is mounted on a stationary column and pivots on a vertical axis by means of ball bearings mounted inside the column. Transversal movement of the gun on a straight line can be 12 feet in length. The gun may also be moved vertically 20 inches above and below a minimum position.

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RBC AIRCRAFT SERIES—#14 VULTEE A-31 VENGEANCE DIVE BOMBER

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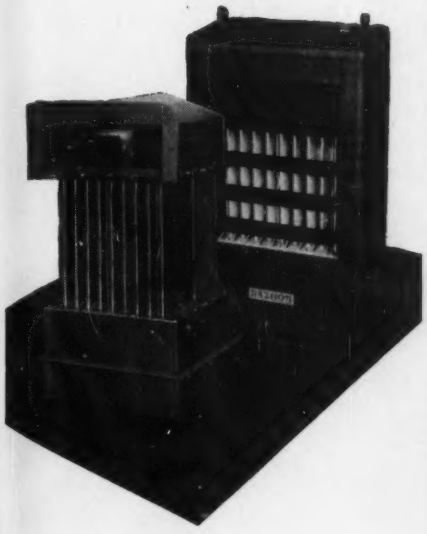
Around 1939-40, Stuka was the synonym for dive bombing. Then along came the powerful, fast, long range Vultee Vengeance Dive Bomber to help back the Stuka virtually off the fighting map. To match its deadly precision in action, precision took precedence in its manufacture—and conforming to that pattern, precision-made RBC Aircraft Needle Bearings were the logical choice for anti-friction bearings. Under these severe service conditions, RBC Bearings are performing with utmost efficiency, keeping moving parts operating with a minimum of friction and wear.

ROLLER BEARING CO. of AMERICA

TRENTON . . . . NEW JERSEY

PUTTING MORE B. T. U.'s TO WORK WITH—

REZNOR UNIT HEATERS



Reznor heat exchanger assembly permits wider distribution of warm air.

● Combustion liberates a certain number of B. T. U.'s, but efficiency of any heating unit is measured by the quantity of B.T. U.'s actually delivered as heat.

The Reznor Unit Heater delivers a maximum volume because the heat exchanger section is designed to permit the air to move quickly and efficiently over the heat exchanger tubes. There are no fins or projections to hold back the steady flow of hard-working B. T. U.'s. The compact, self-contained Reznor Heater is easily installed . . . can be relocated without difficulty. Printed data available upon request.

REZNOR MFG. CO.

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"GAS HEATERS EXCLUSIVELY SINCE 1888"

of the autogyro and the helicopter for many years, would like to take this opportunity of sounding both a word of caution and encouragement.

The engineering possibilities of successful development of a helicopter are definitely assured. In our opinion there is no engineering requirement, in producing practical, commercial helicopters, that is beyond solution. It is our belief also that solutions will become available within a relatively short time.

A ship that will meet the safety requirements of a commercial helicopter and enable the average automobile driver to handle it with ease, must have built into it the following qualities:

1. Inherent dynamic stability
2. Hands-off controllability
3. Freedom from rotor resonance
4. Maximum lift per horsepower
5. Maximum forward flight speed
6. Economy of construction
7. Simplicity of arrangement for passengers and for freight compartments.

From an engineering point of view, there are still many problems that must be solved. With the interest of many aircraft and automotive manufacturers in this field, it appears that many able minds will be applied in the very near future to solutions of the essential problems.

The helicopter, aside from its military application, will be used as shuttle craft for large transports, as a flying machine for the busy executive, for transportation of perishable goods (especially for short distances), for mail pick-up in rural communities, for patrolling of forests and other public and utility property, and for spraying crops, Coast Guard patrol, ship-to-shore landing of passengers, advertising purposes, etc.

In our opinion, the helicopter of tomorrow will have to be designed with at least nine vital factors always in mind. These are:

1. The single rotor, for sustentation, has been clearly indicated as a correct form, compared with the many multi-rotor designs such as those of Breguet (co-axial), or Focke-Wulf (bi-axial).

2. A relatively large sustaining rotor, such as the autogyro advanced so admirably, will continue to have marked advantages.

3. Some simple form of anti-torque correction, such as the small, vertical plane propeller used by Sikorsky, will prevail for some time to come. Owing to the dimensional limitation of that form, several variants will be offered.

4. Improved mechanical design of the power plant, the transmission of power to the rotor, and the rotor hub it elf are essential now, in view of the present available art.

5. Inherent stability of the self-flying ("hands-off" control type) is wholly lacking in the helicopters flying today.

IN AIRCRAFT **VISION for VICTORY**

with a LIBERTY AIRCRAFT MIRROR

In many of the planes now in action over our widely scattered battle fronts, the pilots are getting a perfect image of things in the rear without eyestrain or fatigue by means of Liberty Aircraft Mirrors.

The highest possible quality is essential with so many human lives at stake. That's why all Liberty Aircraft Mirrors are first surface mirrors and as permanent as their glass base. The pilot needs a clean, well defined image without distortion, immediately. He gets it from Liberty Mirrors.

Each warplane equipped with a Liberty Mirror has a mirror built to meet the specific requirements of that plane. Thus the pilot changing from one plane to another gets uniformly good vision at all times, in all planes.

For the duration all Liberty Mirrors go to War—but later these battle tested vision devices will be available for all plane operators.

LIBERTY MIRROR DIVISION

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ARMY E NAVY

The Army-Navy "E" was awarded Liberty "For high achievement in the production of war material".

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Aeronautical Engineers... Specialists in static and vibration test... Design Engineers...Stress Analysts Aerodynamicists... Layout Men ... Loftsmen.

• Get in the fight.

• Help us build more and better fighters for the Navy!

• Write details of availability, education and experience to EASTERN AIRCRAFT Division, General Motors, Linden, New Jersey.

EASTERN AIRCRAFT

DIVISION OF GENERAL MOTORS

LINDEN, NEW JERSEY

Statement of availability required

This marks a need for major improvement. The "hands-off" stability of the autogyro is attainable in the helicopter, and in light of extensive experience should be applied.

6. A high degree of control is achieved in most of the helicopters flying today, as was the case in the Focke helicopter flown in Germany before the war. Much of this control stems from the successful development of direct control of the autogyro here and abroad. In fact, the mechanism of the helicopter controls, in some cases, is not so advanced, requiring further refinement.

7. Vibration characteristics of the rotor continue to remain the most complicated, single problem in advancement of the art of all forms of rotative wing aircraft. Current helicopter successes are marred by repetition of resonant vibratory phenomena, which must ultimately be solved for public use of these vehicles.

8. The actual utility of rotary wing aircraft has been studied assiduously and carried out into engineering reality in many of the later designs of autogyros and helicopters.

9. The long, unbroken record of the autogyro testifies to the practical realization of safety as achieved and attainable. This inherent safety of the autogyro must be equaled by any helicopter if it is to continue to enjoy the present public acceptance. This fact dictates a relatively large sustaining rotor for light unit loading in order that the craft may settle and land slowly enough to avoid catastrophy.

Satisfactory solution of the above important fundamental principles will be through an evolution that may be as painful to the engineer and investor as the development history of the automobile, but the rewards will be equally gratifying.

The automotive industry will, undoubtedly, contribute a flood of new ideas that may simplify the craft and reduce the cost. The helicopter is a type of aircraft which lends itself to automotive practice, manufacture, and assembly.

Manufacturers of various accessories, such as engines, instruments, shock struts, propellers, transmissions, etc., should, and undoubtedly will, develop their products to be specifically applicable to the needs of helicopters.

Military experience with those ships now being built will contribute towards the elimination of many weaknesses that we now know exist in helicopter design.

We are certain that the public will have been granted its long-felt wish for an aircraft that can be flown in safety —granted it's within a reasonably short time after the war is over. But to retain the public's enthusiasm and the

Do You Want TURNBUCKLES?

• Increased facilities now available permit us to offer our technical service and manufacturing capacity to a growing number of manufacturers in the aircraft and allied fields. We are in a position to offer Turnbuckles to meet all requirements of accuracy—uniformity and strength. Also can furnish durable, accurate Terminals and can make attractive deliveries on both items.

Consult BUCKEYE on both your Turnbuckle and Terminal needs.

Quotations will be made promptly from your blueprints or specifications.

Write for further details.

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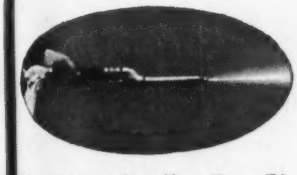
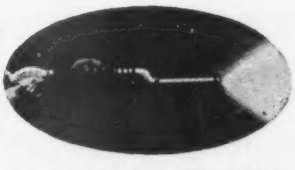
Here's the pump that produces the high-pressure fog that is revolutionizing fire fighting technique!

Delivers 600 lb. Pressure Fog at the Nozzle!



Efficient for use with 600 lb. or more nozzle pressure only.



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FOG FIRE GUN *graduates from straight "power" stream to close-up fog.*

This 3 cylinder, all enclosed, oil bath, plunger type pump is the "heart" of the FMC Fog Fire Fighter. And what a fighting heart it is! Pumps 60 gallons of water a minute; built for much higher pressures it easily gives 600 lb. nozzle pressure (800 lbs. at pump) without overworking. Breaks up water so fine that one gallon properly used has the fire quenching possibilities of 35 low-pressure gallons. Makes fog that puts out fires faster with no water damage and no water shortage.

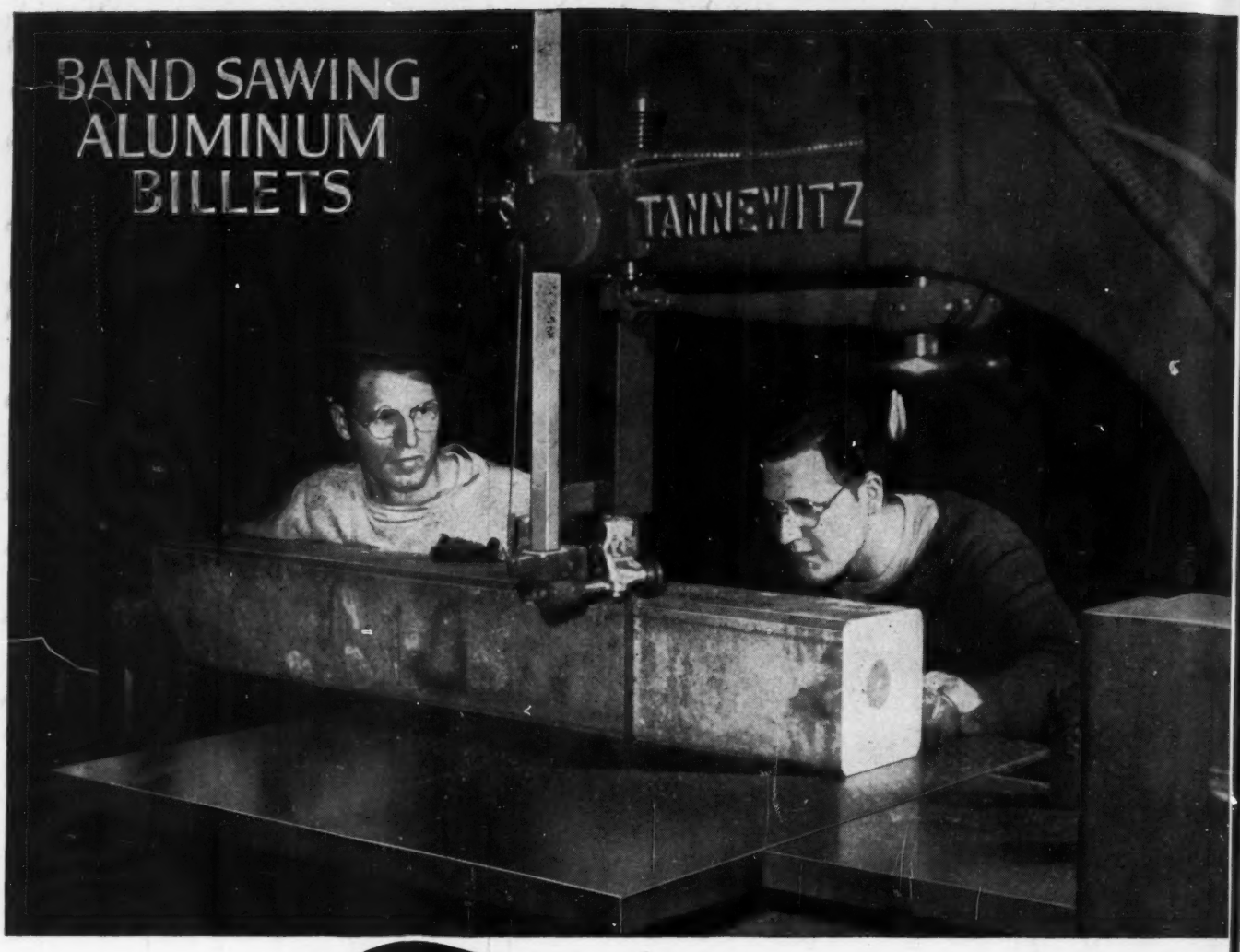
Don't confuse FMC High-Pressure Fog with *any other system.* There's nothing else like it for speed, for efficiency, for all-type fire protection. Proved on hundreds of fires all over the country. Get details from John Bean Mfg. Co., Lansing, Mich., or Bean-Cutler Division, Food Machinery Corporation, San Jose, Calif.

FMC FOG FIRE FIGHTERS *are low cost units. Carry own water and equipment. Several models.*

FMC *Original* FOG FIRE FIGHTER

FOOD MACHINERY CORPORATION

JOHN BEAN MFG. CO., 764 HAZEL ST., LANSING 4, MICH. • BEAN-CUTLER DIVISION, 464 JULIAN ST., SAN JOSE, CALIF.



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Since 1933, we have produced welded tubular assemblies and fabricated alloy steel aircraft parts . . . precision-built products for our own assembly line, and for other manufacturers.

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market that would be thus available, it is important that the public should not be disappointed by unwise and premature propaganda. It is our suggestion that those in the rotary wing aircraft field who have dedicated their lives and in many cases their fortunes towards the successful attainment of a new industry coordinate their plans and their publicity towards a reasonable control of the public's enthusiasm. It is our opinion that in this way, and in this way alone, will the commercial progress of the helicopter development and manufacture be assured.

Investors Confused

(*Continued from page* 197)

of the most complete surveys made. The results are shown in Table I.

The striking fact remains that many of the country's largest trust funds are completely devoid of aviation commitments. In the three month period ended Sept. 30, 1943, only one trust added to its investments in this group, when the Wellington Fund acquired 1,000 shares each in Bendix and Sperry. It is interesting that both of these companies are equipment producers and are not strictly wedded to aircraft manufacture.

Bendix, in the past, has looked to the automotive field for its sustenance and may well return to that industry if future conditions make it desirable. While Sperry is popularly identified with aviation, actually the company's major activity lies elsewhere. Navy installations and various non-aviation industrial products have long accounted for the bulk of the company's billings.

Among the trust holdings, airline equities continue to be more popular than the aircrafts. However, this is a highly relative measure, since air transport issues are hardly in demand with trust funds at the present time.

Pan American remains the leading air carrier investment, with a total of twelve trusts owning an aggregate of 122,800 shares. The importance of investment trusts in the financial affairs of a company is clearly evident when it is realized that this summary shows about 16 percent of Pan American's total stock is owned by these funds.

Liquidation of Pan American, however, has definitely set in, with a number of sales reported during the third quarter. During this period, General American Investors sold 6,000 shares, National Bond & Share 1,000 shares, and Lehman Corp. 3,700 shares. Incidentally, PAA officers, including Pres. Juan Trippe, have been heavy sellers of their stock in recent months, as has been reported in the summaries released by the SEC.

It is also notable that Lehman Corp. sold other airline issues during the third

IT'S WIRY JOE FOR AVIATION WIRE and CABLE

There *was* a time that Wiry Joe was merely the largest independent manufacturer of replacement wiring for the automotive industry.

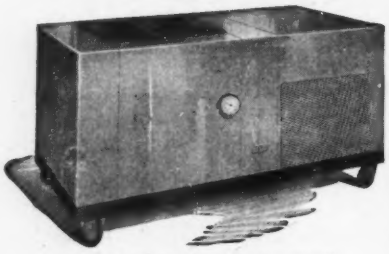
Now, Wiry Joe is also known as an important source of supply for every type of electrical wire and cable for aircraft. The complete line includes starter cable, high-tension cable, primary cable, both original and replacement. Wiry Joe also makes power and welding cable.

And just as Wiry Joe automotive cable won a name for quality, so, too, has Wiry Joe aviation cable. Every item in the line is built to meet rigid Army and Navy specifications, and is produced under the Dostam method of manufacture for uniformity, dependability, high efficiency and long life.

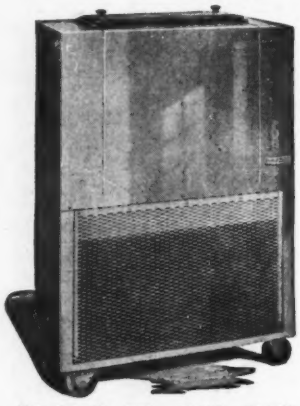
Inquiries regarding wire and cable for any type of service will be answered promptly.

Wiry Joe
AVIATION CABLE
manufactured by
THE CRESCENT COMPANY
Pawtucket, Rhode Island

"One-Two-Three-Four-Testing!"



5.4 Cu. Ft. 32" x 34⅞" x 63½"



2.0 Cu. Ft. 48" x 24⅛" x 34⅛"

The chant of the Army or Navy radio operator preparing for action, is definitely allied with Kold-Hold thoroughness and accuracy in developing testing equipment for radio and airplane parts.

Kold-Hold Sub-Zero units provide accurate temperature control conveniently located for the operator at one spot.

The applications of Sub-Zero machines include the testing of airplane instruments, radio receivers and transmitters, conductor wire, crystals, insulators, plastics, glass, lubricating oils, paints, chemicals and others too numerous to list. What are your requirements?

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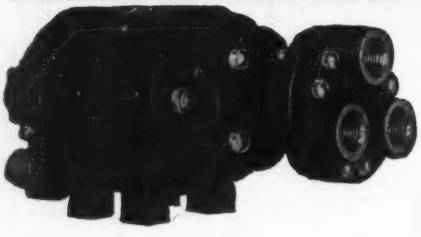

WELDON *Aircraft*

FLUID METERING PUMPS

ANTI-ICING PROTECTION
for Propellers, Carburetors, Windshields and other Vital Parts

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UNIFORM DELIVERY
at UNEQUAL PRESSURES

● A quarter century of experience in the manufacture of high quality precision cutting tools eminently qualifies WELDON to produce this Aircraft Fluid Metering Pump which has won complete acceptance because of its unfailing performance under the most exacting operating conditions. Rigid tests through extremes of altitude and temperature have demonstrated its dependability.

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quarter. Sales comprised 4,400 shares of United Air Lines and 500 of American. This trust still owns 40,775 shares of Aviation Corp. which it acquired a number of years ago. Present indications point to further sales of airline shares by Lehman Corp.—at least recent moves are in that direction. This trust, as of Sept. 30, held the following air transport shares: American 1,600, PAA 16,300, and United 22,600. It no longer owns any aircraft manufacturing issues other than The Aviation Corp.

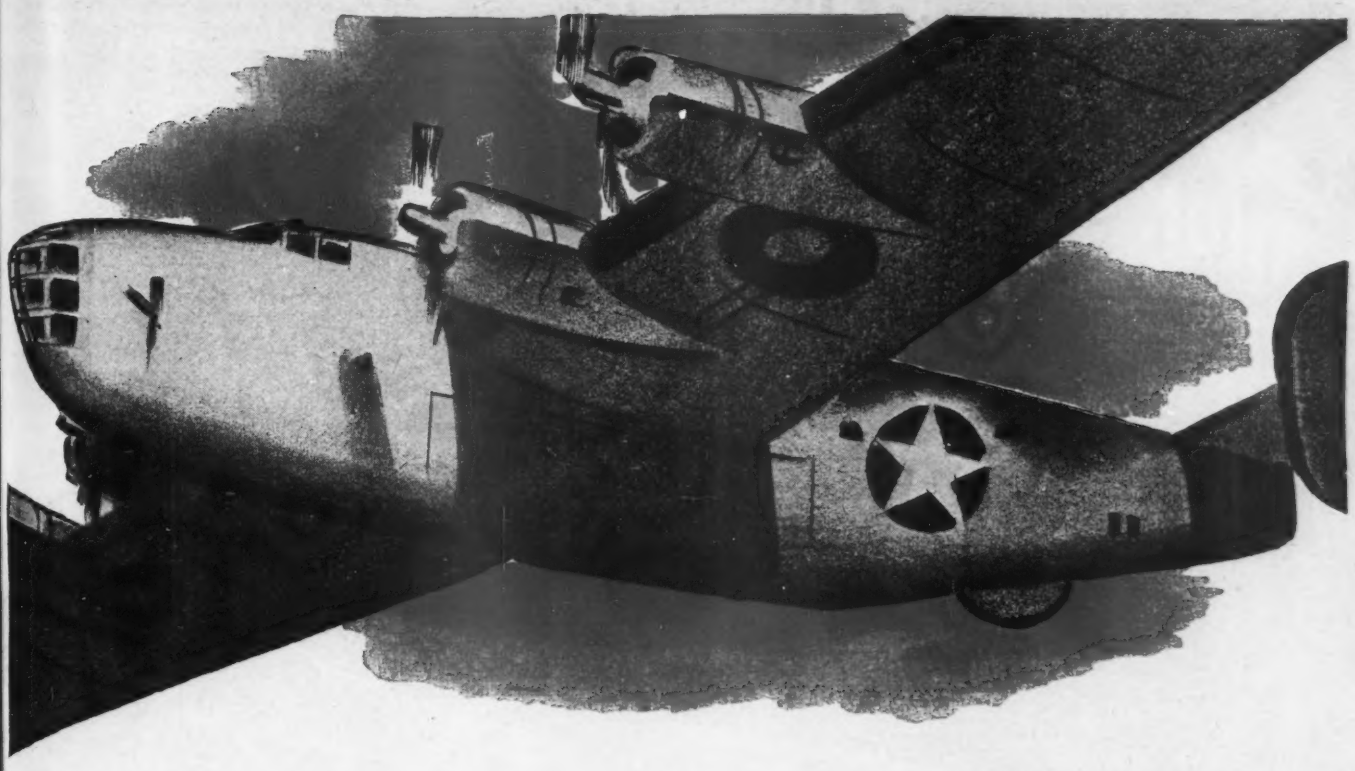
Unchanged in their airline holdings during the third quarter were a number of the country's largest trusts. These funds are Incorporated Investors, Massachusetts Investors Trust, Tri-Continental, and Selected Industries. Large blocks of American, Eastern, Pan American, and United are owned by these trusts. The 16,000 shares of Northwest, shown in Table I, are held by Incorporated Investors.

A curious sidelight was revealed in the examination of the trust portfolios. Greyhound Corp. is a highly popular issue and was very much in evidence among the trust funds. If nothing else, this may be construed as a tribute to the surface carrier's position and recognition of its management ability. In view of the bus company's announced intention to attempt entry into the air transportation field, it may be well for the air carriers to note how well Greyhound is regarded and how serious its aspirations can become.

Greyhound Corp. is a holding company and owns or controls 15 operating motor carriers. In the aggregate, these companies provide the most extensive motor bus service in the United States, operating 830,000 mi. daily. The holding company last reported total resources of about $36,500,000 compared with almost $29,000,000 for American Airlines and about $27,000,00 for United Air Lines.

More light on how aviation shares are now regarded by the investment trusts is given by the action of National Aviation Corp.—a fund established to deal exclusively in aviation securities. This has all been changed, however, and aviation equities are being constantly liquidated.

How far the trust has moved in this direction is indicated in Table II. The aviation portfolios as of Dec. 31, 1942 and Sept. 30, 1943 are presented, and they show the evidences of extensive liquidation. The tabulation speaks for itself, and no added comment appears necessary other than to note that commitments have been increased in only two issues. This is the purchase of an added 900 shares of Douglas and 500 shares more of United Aircraft preferred. These acquisitions are, by com-



THERE FLIES 15 TONS OF HEAT TREATED AL-MG ALLOYS

Why Metallurgists Choose Despatch Furnaces For Such Jobs

A bomber like this is built for trouble—from nose to tail. And most of her 15 tons of tough, light aluminum and magnesium alloys owe their strength to exacting *heat treatment* in specially designed furnaces.

To provide such furnaces has been the role of Despatch engineers for years. So today a very large percentage of *all* non-ferrous alloys used in our military and naval aircraft are "Despatch-processed". Why? Because they are convinced by *proved* performance that Despatch furnaces provide exactly the kind of heat treatment required—swiftly, surely, economically.

PROVIDE BETTER CORROSION-RESISTANCE

Take the bugaboo of corrosion. To get real resistance means most accurate heat treatment and almost split-second quenching. No easy job!

But Despatch engineers developed an electronically controlled dual-zoned type conveyor furnace (shown below) which does the entire job *automatically!* Such high corrosion-resistance was developed that a second furnace was ordered at once for another plant.

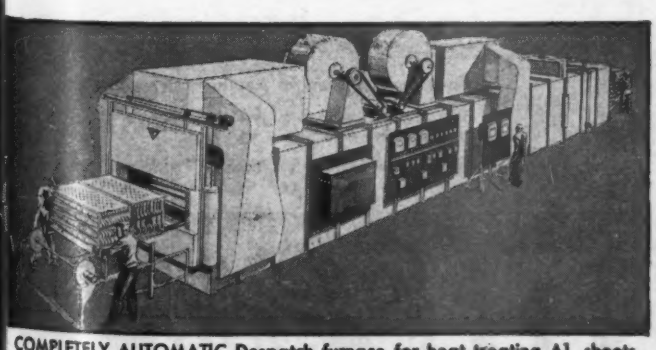
DESPATCH SYSTEM GIVES HIGHEST METAL FACTORS

This is but one example. There are scores of others involving other types of Despatch furnaces for castings, shapes, billets, preforms and rivets.

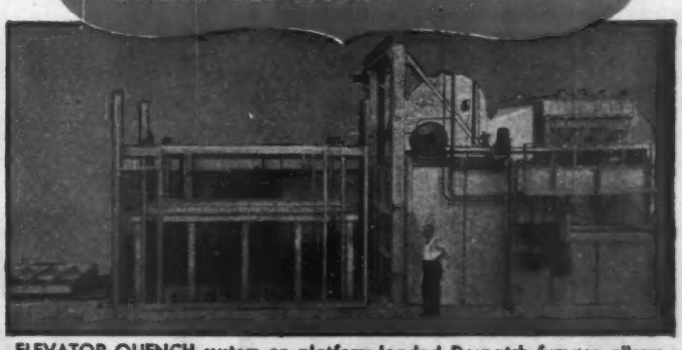
In all types, however, the unique forced convection system is so powerfully efficient that *maximum* physical factors in tensile and elongation are developed. You get just what you want. And electronic controls, robot conveyors, extra-fast quench systems and other new features help make the job easier and *better*.

WE CAN HELP YOU *with your non-ferrous heat treating problems promptly and efficiently, and also assist you in planning* your *future in the light metals industry.* ASK FOR DETAILS TODAY!

DESPATCH
OVEN COMPANY MINNEAPOLIS



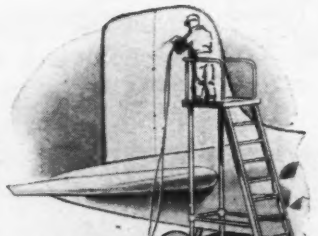
COMPLETELY AUTOMATIC Despatch furnace for heat treating Al. sheets, 400 lbs. per hour. Time-cycle controlled conveyor, doors, quench. Uniformity ± 5° F. Eliminates all labor, except for loading.



ELEVATOR QUENCH system on platform-loaded Despatch furnace allows removal and quench of 8000 lbs. of castings in 20 seconds! Electric or gas-fired (radiant tubes). Very efficient.

Many spectacular savings in time, money and manpower have been accomplished by Mahon engineers in adapting Mahon Industrial Equipment to the war production program. Outstanding among these achievements was the development of the spray painting and ventilating system, pictured above, for the camouflage painting of completely assembled bombers. This gigantic, 3-level ventilating equipment—a multiple assembly of Mahon Hydro-Filter Units, combined with a mammoth Mahon Filtered Air Supply System—performs a double function. It clears the enclosure of dangerous overspray and fumes and continuously floods the entire space with tempered, washed and filtered air, maintaining an equalized air flow throughout the 150′ wide, 200′ long, 35′ high enclosure. *Four* of these immense systems already are in operation. The *fifth* soon will be in service.

If your production necessitates equipment for CLEANING . . . . RUST PROOFING . . . . SPRAY PAINTING . . . . DRYING . . . . BAKING . . . . or DUST CONTROL . . . . Mahon engineers will cooperate in working out a solution to whatever problem confronts you.



Many other installation

of MAHON *built-for-the-jo* EQUIPMENT are proving the value in ECONOMIZING an EXPEDITING the production o war essentials. Here are typic examples . . . .

System for Cleaning and Treating Aluminum Airplane Eng Pistons

Shrink Oven Installation for Pre-Assembly Heating of Airpl Engine Cylinder Heads

Finishing System for Shell Cases

Finishing System for Ammunition Boxes

Impregnating System for Airplane Engine Castings

System for Painting and Baking Core Moulds for Alumi Airplane Engine Castings

Dust Control System for Airplane Propellers

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Manufacturers of Metal Cleaning Machines • Rust Proofing Machines • Hydro-Filter Spray Booths • Ovens of All Types • Filtered Air ply Units • Hydro-Foam Dust Collectors—and Many Other Units of Special Production Equipment—including Complete Finishing Sy

For Victory! . . . Excel-So is helping guard the Fuel Lines on American Home & Foreign Fronts

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Firsts

IN AVIATION

THE LEWIS EXCEL-SO WATER SEPARATOR

Men who know fuels from the ground up designed and built Today's outstanding fueling unit for American and Foreign airports, portable pipelines, truck loading racks and refueling trucks . . . ***the Excel-So Water Separator that means so much to pilots, for water-free gasoline insures safe take-offs and worry-free water problems while in the air.***

Excel-So was first to deliver gasoline containing not more than 1/100 of 1% of undissolved water, where abnormally high percentages of water, free or emulsified, were involved.

Excel-So is the only separator to guarantee delivering gasoline containing not more than 1/500 of 1% of water, free or emulsified.

Excel-So is the only separator that delivers gasoline 99.999% water-free, proven by tests in collaboration with Government testing engineers.

Excel-So is first to introduce the dual principle of coalescing and settling of emulsified water in gasoline. Most separators rely solely on the settling chamber.

Such high efficiency of water removal by Excel-So cannot be approached by any other type unit!

Simple in design . . . employing no moving parts . . . dependable automatic features and equipped with a scientifically designed coalescing and filtering media . . . Excel-So separators are not only establishing new records in delivering water-free gasoline, but new standards in gasoline free of silt, dust, muck, etc., to planes, refueling trucks, pipe lines, mobile equipment, tankers, barriers, tenders and other craft and motorized equipment.

Built in sizes from 25 to 1000 gpm at new low pressure differentials, Excel-So separators can be used on all existing fueling systems.

Excel-So Separators are also designed and built ***to handle Diesel fuels and kerosene.***

All features in Excel-So Separators—design, operating and processes of degumming filter media—are covered by patent applications.

When writing for special requirements covering your water separation problems, please give actual operating pressure, maximum and minimum rates of gasoline flow, approximate amount of water to be removed and current characteristics of pump motors and available current for electronic control.

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parison, inconsequential and hardly offset the many sales made in other issues.

By its moves, National Aviation Corp. merely confirms the uncertainty and doubt prevailing throughout the investment fraternity in respect to the future of both branches of the aviation industry. When in doubt, the policy appears to be to sell and step aside—to wait for events to tell their own tale.

Investment advisory services also mirror the confusion pertaining to the outlook for aviation equities. Eliminating all the qualifications found necessary in issuing opinions of this type, most of the investment services seem to favor giving the aircrafts a wide berth, but they are not adverse to selective nibbling at the airlines.

In speaking of the aircrafts, one service says, "We believe this group of stocks lacks attraction. . . . Later on these stocks will, no doubt, acquire real promise. But we do not believe they are in that position now." Another organization, in reviewing the airline picture, has this to say: ". . . Summing up, one may correctly say that air transport is today the most promising and interesting growth industry with large speculative profit possibilities commensurate with the risks involved."

Shades of opinion differ, but confusion prevails as to the ultimate pattern to be followed by aviation securities.

America at War

(*Continued from page* 113)

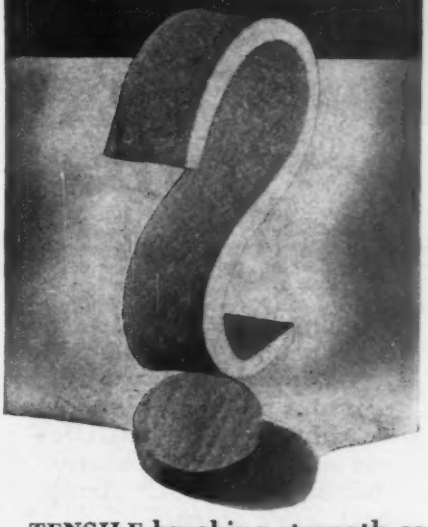
the total take of enemy planes was 350.

Incidentally, the 8th Air Force recently completed its 100th mission, hitting important non-ferrous metal plants at Duren. Incidentally again, AAF officers abroad frown on the common habit of calling a bombing attack a "raid." That word, they say, connotes a hit-and-run tactic as old as war. Strategic bombardment is an aerial invasion by the major weapon of modern war.

Complete air supremacy has been established by Allied forces in Italy. Some military men are surprised that the enemy can put up such strong ground resistance with such weak air support. But we do not have command of the air over Germany by any means. We can go in at will, but we always pay a price. Anti-aircraft fire comes up from guns planted as thick as the hair on a dog. The power and the accuracy of these A-A guns is constantly improving, and apparently little can be done about it.

Then again, the resistance of German fighters is determined, skillful, and heavy in numbers. As these Communi-

How strong CAN felt BE MADE



TENSILE breaking strength as great as 1016 pounds per 2-inch width was observed during laboratory tests of 2″ x 10″ strips (0.375″ to 0.5″ thick) of six different Booth felt types.

Almost any desired combination of qualities . . . durability is only one . . . are obtainable through the *controlled* manufacture of Booth "prescription" felts and precision die-cutting into mechanical parts. Read Booth's "Technique of Felt Making."

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APPLICATION CHART AND SAMPLE KIT . . . Contains swatches of S.A.E. felt types, with specification tables. Write for it. (No sales follow-up.)

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NAF 47089

oil separator

This efficient oil separator, used as a part of the de-icing equipment on many military planes, is supplied by MERCURY to leading aircraft manufacturers of both Army and Navy ships.

Improved methods and quantity production have put us in a position to deliver these vital parts promptly in any quantity needed.

dependability

MERCURY know-how, developed over 23 years devoted exclusively to aircraft fabrication, makes this company a dependable source of supply of aircraft parts and accessories, assuring quality unswerving and deliveries on schedule.

aluminum fuel and oil tanks • ailerons, fins, rudders and similar surfaces • aircraft parts and accessories.

AT *The Cradle of Aviation*

MERCURY AIRCRAFT Inc.
HAMMONDSPORT · NEW YORK

ques have reported before, the Nazis have virtually stopped building bombers. Nearly all of their great production capacity is reported to be at work on interceptor equipment and on trick weapons developed in rapid succession in a vain hope to win by a stroke of genius or luck.

Yet the force of German fighters does not seem great, compared with our potential fighter strength. Fairly reliable reports give them 3,000, two-thirds in action against the British and Americans and the other third against the Russians. The 2,000 against the Allies in the West are supposed to be divided about half and half between night and day work. It doesn't sound like a big-league air force, but it's on the defensive and it is desperate.

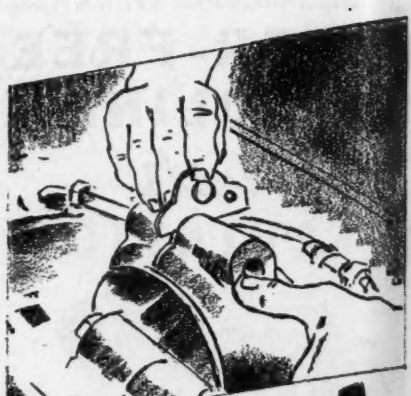
U. S. Army fighter power against Germany, made up mostly of Lockheed P-38's, Republic P-47's, and North American P-51's, is now at about half its planned strength. But these types are now pouring out of our factories, and it is expected that quotas at the fronts in England and the Mediterranean will be doubled shortly after the new year. It can be said that the Army no longer has any expectation (if it ever had) of fighting the B-17's and B-24's without escort. Bomber guns and gunners have been doing a fine job, taking heavy toll of the enemy. But the cost unescorted was too great.

What will happen in this respect when the new Boeing B-29 goes into action—in whatever theater it moves first—remains to be seen. Called by Gen. Arnold a "battleship of the air armored heavily with multiple gun and power turrets" and with a "range substantially greater than the maximum effective range of today's longest-range heavy bombers," it may well go on the prowl alone.

Going back to those trick weapons, the Nazis have "silver fire", phosphorescent disks, released in large numbers in the flight path of attacking planes. They set fire to ships on contact, but apparently contacts are infrequent. Other twists: Rocket throwers are being used, both in planes and on the ground, to project extremely powerful shells. Time-fused bombs are dropped in the way of attacking planes. Radio-controlled glider bombs have been used by the Germans against surface targets, but apparently not against airplanes.

These weapons can inflict damage as yet unestimated, but obviously they cannot stop Allied aerial invasions in strength.

Worth notice, among the bigger developments, is the recent acquisition by Britain of naval and air-base rights in the Azores, which belong to Portugal. Land-based aviation can range around these islands at considerable distances, thus relieving naval patrol forces for other duties.



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2044

1. Tail Leveling Jack in closed position — minimum height 6 inches.

2. Same Jack — at fully extended position. Hydraulic lift 60 inches.

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To safely swing the tail of a fighter, bomber, or cargo ship in flying position to test instruments or aim cannon... is the job this ingenius Malabar Tail Leveling Jack does... in 5 minutes.

Available in minimum heights from 6 inches; hydraulic lifts up to 100 inches. Capacities 1000 lbs. to 10 tons. Also with Malabar Weight Finders.

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Since automatic controls are essential to modern, mechanized warfare, the greater part of our production is devoted to turning out vitally necessary precision built equipment.

The specialized skills used to hasten the day of Victory will also serve after the peace is won. When that day comes, knowledge gained from wartime experience will be used to good advantage.

Automatic controls will give the American of tomorrow even higher standards of living and production efficiency than those now enjoyed. We will be ready to maintain our reputation as pioneers and leaders in this field.

THIS IS AN 8½ OZ. valve designed for cabin heating, oil dilution, and anti-icing aplications. Operates in any position, regardless of vibration, change of motion or acceleration. Although "g" factors as high as 300g areobtained, valveweight is only a fraction of a pound. Available for handling all fluids, gasses, vapors and vapor mixes. WRITE FOR BULLETIN.

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Wartime Manufacturers of Electro-Magnetic and Temperature Controls for Aircraft • Peacetime Producers of Automatic Pressure, Temperature, and Flow Controls

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Lifting Speed (1,000 lb. unit)	10 ft. per min.
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Platform Size	26", 30" or 36" wide by 36" or 42"
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Standardized in size and capacity . . Fabricated in quantity

SAFE—Twin roller lifting chains (either will hold)
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This efficient, well-designed Service Electri Hydraulic Lifter will save you time and mone by helping you make more efficient use o storage space and by speeding up materia handling. AVAILABLE NOW FOR IMMEDI ATE SHIPMENT. Most sizes are now in stock Wire or write for prices or Bulletin L-109.

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ARMY E NAVY

TRUCKS, CASTERS AND SPECIALLY DESIGNED LIFTING AND HAULING UNITS

Here at home the main thing to notice is the aircraft industry's 10 percent increase in numerical production. Nearly every one is betting on a rate of 9,000 per month before the year ends, and some will even go along for the planned rate of 10,000. Donald Nelson, chairman of WPB, says the high rise from the 7,000-odd plateau that had been worrying him and a lot of other people was due to more efficient use of man-hours and to standardization of some models which had been subject to a stream of design changes.

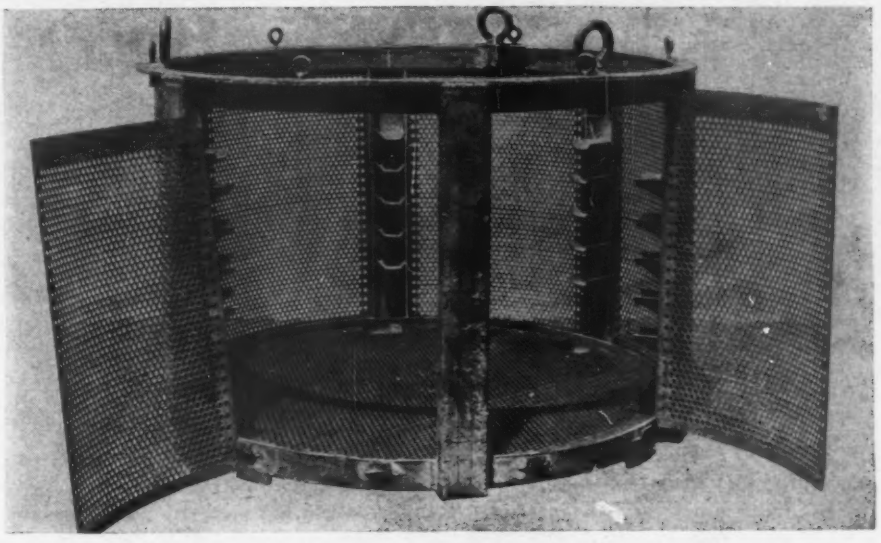
Still at home, the War Department announced that "land power and air power are co-equal and interdependent forces, neither an auxiliary of the other." But no one paid much attention. The War Department says something like that every time there is a flurry of pressure for a "separate air force," and there has just been another one. People are getting used to it.

All is fairly quiet on the civil aviation front, or was while this was being written, because a lot of different groups were off in corners cooking up various plans. Included have been at least two factions whose proponents have different ideas on postwar operations by American airlines. Also, a half dozen groups want to write the Lea legislation their own way, particularly those parts which deal with competition between surface carriers and airlines, with "federal intervention in states rights" concerning aviation, and with that old question whether CAB should be in the Department of Commerce or not.

Over in the Oriental theater you can hear hammering behind the scenes, the lights are getting dim, and it looks as if the curtain is about to go up. The Japs know—just as well as the Commander in Chief at 1600 Pennsylvania Ave. knows—that they can expect at least two plagues to come upon them. One will be an ever-increasing rain of bombs on their myriad fighting-line bases from land based craft, and the other will be the Navy's augmented carrier force, which is now big enough to throw into the Jap empire an air attack comparable in strength to many of those now coming down on Hitler. The carrier fleet is nearly as big as the battleship fleet, and you can add that up from memory or old newspapers.

The new flat-top flotilla consists of regular fleet carriers, basing 60 or 80 or more planes apiece, plus scores of auxiliaries basing 5 or 10. The number of fleet carriers can be doubled in 1944, and the auxiliaries can be tripled or better. Then in 1946, if the war goes on, the new 45,000-ton carriers will be in action.

The above is a justifiable burst of accurate enthusiasm for achievements. Don't forget what the generals told us



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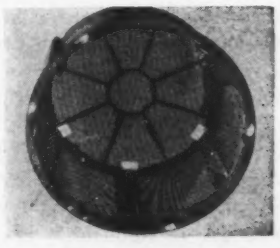
LIKE all Pressed Steel equipment, P. S. installations, regular and special, are in tune with the aviation industry. They are *light*, weighing 70% less than the ordinary, and they are *fast* in producing the best results in heat treating operations.

Over 15 years of specialized experience in the manufacture of Carburizing and Annealing products enables The Pressed Steel Company to furnish equipment that will last long, operate economically and contribute fully to the exacting demands of aircraft production.



Wire or write for the services or counsel of our expert aviation analysts.

THE PRESSED STEEL COMPANY
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PRESSED STEEL COMPANY PRODUCTS: Carburizing and Annealing Boxes, Thermocouple Protection Tubes, Seamless Steel Cylinder Cops, Seamless Steel Neck Rings, Welded Alloy Tubing for High Temperature and Corrosive Application, Radiant Tubes, Inner Covers and Base Sheaths for Steel Mills

★ Carpenter Welded Stainless Tubing can withstand severe bending and forming, as clearly shown by these light gauge tubular parts.

The uniform wall thickness of this tubing permits you to use *lighter gauges* without sacrificing strength. And lighter gauges mean less weight, easier fabricating and considerable materials savings.

Parts made from Carpenter Welded Stainless Tubing have *longer service lives*—because there are no "thin spots" to give corrosion or heat scale a foothold.

To safeguard the uniformity and quality of Carpenter Welded Stainless Tubing, exacting inspection standards are maintained and hydrostatic tests are made at the mill. Take advantage of Carpenter's experience with problems involving Stainless Tubing. Get in touch with us today.

CRUSH TEST—The even "fold" here shows the weld's ability to withstand even the most severe forming and bending operations.

Carpenter's "Quick Facts" bulletins make it easier to apply the advantages of this type of tubing to YOUR products. And you'll find them packed with helpful hints on the fabrication and use of Welded Stainless Tubing. A note on your company letterhead will start your series on its way.

CARPENTER WELDED STAINLESS TUBING

- resists corrosion, heat and wear
- meets Government specifications
- is furnished in various types to meet specific conditions in service

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division, Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING

when the Japs swung on us: The Nippons are so far away and so well situated militarily that we will need ten times their power, in terms of quantity and quality of weapons, to beat them.

Eng. in Airline Maint.

(*Continued from page* 137)

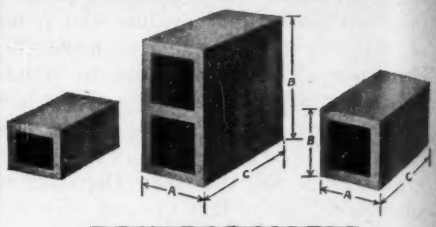
plane. This is a purely hypothetical case for purposes of illustration.

A mechanic on a specially trained winterization crew that yearly installs wing de-icer boots on DC-3 airplanes notices that by a simple revision to the procedure in attaching the inflatable rubber boots to the wing, a more durable job can be accomplished and at the same time ten man-hours per installation can be saved. He informs his foreman of his idea. His foreman, agreeing that it is a good suggestion, makes a written report of the improvement and sends it to the general foreman of airplane overhaul, who discusses it with the superintendent of overhaul. After a little time, if it is agreed that the idea has merit, a recommendation is made (with the approval of the director of maintenance) that the new method be investigated. This recommendation then takes the form of a request for engineering service, and as such it is put on the list of projects upon which maintenance wants engineering to concentrate.

At the same time that the request for engineering investigation is sent to the engineering department, it is assigned a priority by maintenance classifying it as "urgent", "rush", or "static", depending upon its importance in the eyes of maintenance. In this way, maintenance itself can specify on which of its engineering requests it wants first delivery. Knowing what the job entails, also what importance is placed upon it from a priority point of view, the chief engineer issues a job order to the proper project engineer, in this case the deicing engineer, outlining the nature of the service requested, the scope of the investigation required, and the priority assigned.

Consistent with the priority given, the project engineer starts an investigation of the proposed method of installing de-icer boots to determine if it is practical from an engineering point of view and also if any safety standards are involved. If preliminary investigation is satisfactory, he writes a letter to the manufacturer of the de-icer boots, outlining the proposed revision and asking for his comments and approval. If the change is such as to require a review of the safety factors involved, the Civil Aeronautics Authority is consulted, usually by the manufacturer, and if both the manufacturer and the CAA are agreed upon the merit of the idea, approval is then given the airline engineer to proceed.

Specify CHALLENGE SURFACE PLATE EQUIPMENT



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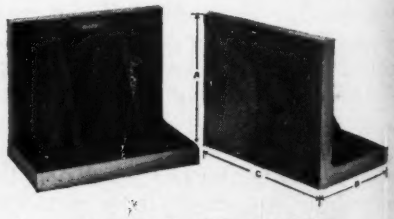

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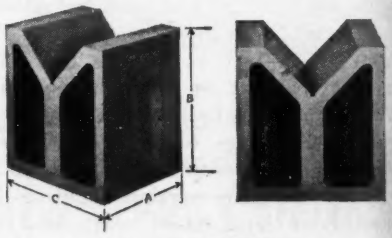

V - BLOCKS

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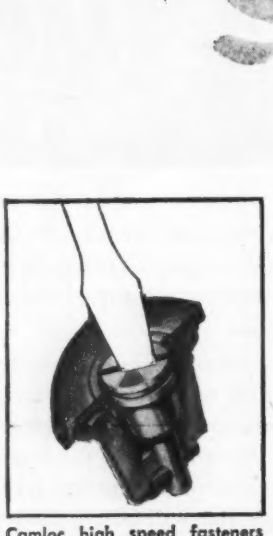
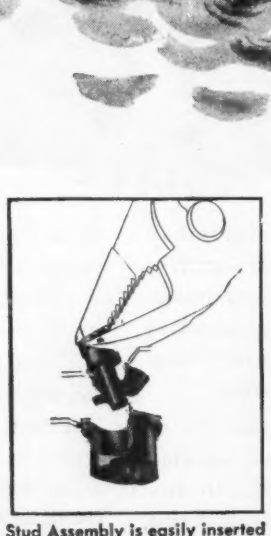
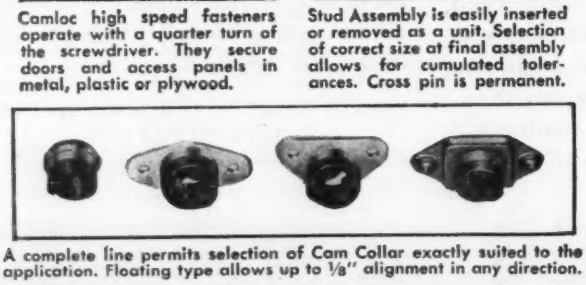


Camloc high speed fasteners operate with a quarter turn of the screwdriver. They secure doors and access panels in metal, plastic or plywood.



Stud Assembly is easily inserted or removed as a unit. Selection of correct size at final assembly allows for cumulated tolerances. Cross pin is permanent.



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The engineer next arranges with the manufacturer to obtain a service test set of de-icer boots incorporating the changes agreed upon, writes an engineering release including a set of specific installation drawings and instructions, and arranges with the maintenance production engineer for a special service test on one DC-3 airplane.

Briefly, this engineering release contains the following information:

1. Code designation number
2. Scope of release
3. Priority
4. Airplane
5. List of people receiving copies
6. Classification and subclassification for filing purposes
7. Positive and complete statement describing the change and authorizing its adoption
8. Reasons for the change—explanation of what it is expected to accomplish
9. Information as to the details of delivery of the parts, purchase order number, etc.
10. Name of engineer supervising the initial installation
11. Organization requesting this change
12. Estimated weight change
13. Estimated cost or saving in cost
14. Approval of engineering department
15. Approval of maintenance department
16. CAA approval
17. Manufacturer's approval
18. List of drawings and instructions attached
19. Remarks

When signed by the chief engineer, this release indicates that the engineering department has evaluated the original suggestion and has given its answer. This answer stands and cannot be changed except by a subsequent engineering release.

The engineering change is then worked into the shop schedule by the maintenance production engineer when the service test parts arrive from the manufacturer. A service test installation is made under the supervision of the project engineer and perhaps with the assistance of a manufacturer's representative, and the airplane is test flown by the engineering test pilot. When all has been checked and approved, the airplane is released to operations with a special placard in the log book inviting pilot's comments and also calling the modification to the attention of line maintenance mechanics who may come in contact with it.

At the end of the service test period, usually 60 to 90 days, the entire performance record of the change is reviewed by engineering and maintenance in order to reach a decision as to

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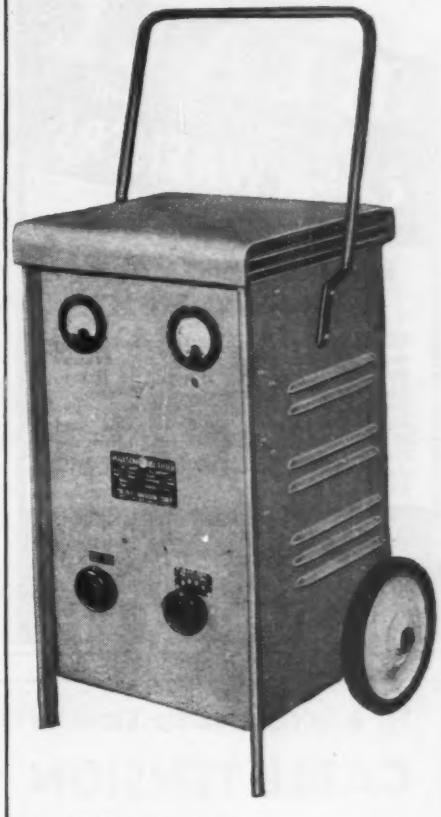

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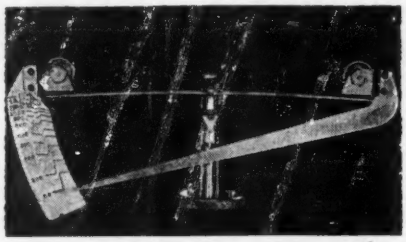
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the results of the test installation. If the idea has proven its worth in actual operation, and if the design and instructions are satisfactory, the project engineer issues a new engineering release similar to the service test installation authorizing maintenance to make a production change altering all airplanes in the fleet. Thus the new idea of a mechanic on the job becomes a standard and acceptable company practice.

A close-up view of the interweaving exchange of facts, opinions, and paper work between engineering and maintenance in even so simple an example as the case illustrated indicates that one of the main factors in making the system work is cooperation. Teamwork is the priceless ingredient in considering the engineering aspects of airline maintenance.

Ranger Service

(*Continued from page* 153)

large complement of well-trained personnel whose duty is to make field contacts to assist those employing Ranger engines so that they will get the best possible service from the product. These employees maintain a close liaison with Farmingdale headquarters, operating through the medium of regional supervisors. Territory within the continental limits of the United States is divided into geographic sections proportional to the number of company engines in operation.

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All field service representatives are truly technicians. It is not intended that they handle the tasks of a traveling mechanic, for it has been found that wherein the factory steps in and makes field repairs at the request of a customer, both the customer and the factory have lost an opportunity to increase their knowledge. These men demonstrate a willingness to pitch in when immediate action is necessary to get an aircraft back on flying status but, in general, their function is that of acting in an advisory capacity.

The similarity between the manufacturer's two basic designs of 6- and 12-cylinder engines enables the representatives to be versatile in their operations to the extent that there is an appreciable saving in man power, it being possible to work on equipment operated by the Army, Navy, or Coast Guard with equal facility.

Postwar Markets

(*Continued from page* 115)

tion of them will be diverted to commercial use so that there will be no need whatever for new commercial planes. Such pessimism, however, ranks with the vague optimism that sees the skies darkened by planes.

Looking realistically at the situation, we find the following conditions: The longer the war lasts, the greater will be the difference between military and commercial aircraft. Even today, practically the only military planes adaptable to commercial use are the cargo and transport planes. And they would need considerable modification to be converted from military to competitive commercial operations. As military models they are heavier (due to beefing up and inclusion of tactical equipment) than are straight commercial types, and therefore they are considerably less efficient in ton-mile operation cost reckoning.

Analysis of the over-all V-2 transport market shows it to be at greatest variance with prophesies of the visionaries who see practically everyone and every-

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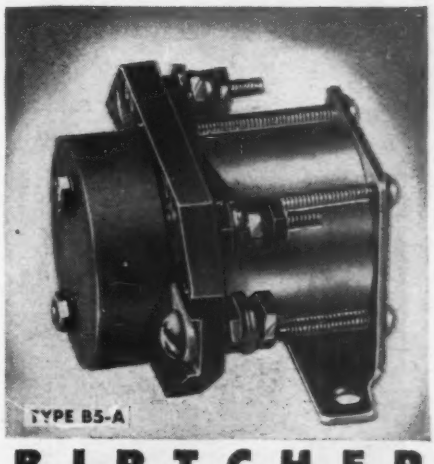

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thing moving by air. Based on experience which has yet to be disproved, and evaluating countless interviews with hard-headed airline operators, the forecast for transport craft for the two-year period following the coming armistice is set at 1,700 planes, valued with spares at $512,500,000. This market is for new planes which will probably be available within 18 mo. to 2 yr. after cessation of hostilities.

No figures are presented for the transition period, for this market will necessarily be made up of planes, best suited to airline operations, which can be obtained from the government and manufacturers—such craft as today's Douglas C-47 *Skytrain* and C-54 *Skymaster;* Curtiss C-46 *Commando;* Lockheed C-60 *Lodestar* and C-69 *Constellation;* and Consolidated Vultee C-87 *Liberator Express.* It is believed that most such craft will be purchased new directly from the manufacturers, since airline operators feel that reconversion costs on planes bought from the government would be too high in proportion to serviceability of new craft.

Moreover, it is understood that major U. S. airlines are unlikely to be willing to accept wartime transport planes for conversion to competitive commercial aviation, as has been proposed. Even though it would require more time, they would prefer to await newer, more efficient models which can be built at costs in line with those of conversions.

Already, in fact, five airlines are joining with Douglas in plans to assure the earliest possible delivery after the war of new DC-4 transports which, while smaller than the prototype, are expected to have greater capacity and better performance.

A break-down of the total 1,700-plane V-2 market shows that 1,500 planes valued at $375,000,000 can take care of the domestic passenger and cargo business which the airlines themselves believe they can build up. Here, the phrase "build up" is used advisedly, for no sensible operator believes the ticket counters and cargo docks will be flooded with travelers and merchandise. Fact is that transportation will have to be sold, just as it has had to be sold in the past. It must be understood that, based on cost, the domestic air passenger market will first have to be secured through penetration into Pullman travel field; thus the early post-war potential market will be the Pullman plus current air travel markets. Today's peak war-demand for air travel, meantime, will have to be translated into peacetime operations, which will again require selling because of the cost differential.

The air travel volume will be to some extent dependent on economic conditions of the period, since a great many of the air transport patrons have, to date, been traveling on someone else's money—on expense accounts used for business travel.

Based on past penetration records, however, commercial airline passenger traffic may be expected to approximate 33 percent of the domestic travel market for the V-2 period, increasing to 54 percent for the V-5 market.

The V-2 domestic transport market does not envision vast fleets of straight cargo planes. In fact, it is believed that not more than 10 percent of the total will be solely cargo carriers with the remaining 90 percent being dual-purpose craft.

For American-operated transocean and international lines, the study reveals a need for not more than 100 new craft valued at $50,000,000 for the first two years after the war. This calculation is based largely on expected penetration into the waterborne transportation market. Based on Class A passenger traffic, air transport may be expected to secure 28 percent of the field for the V-2 market and up to 80 percent for the V-5 projection. This figuring is also based on the blunt fact that air travel now costs—and will continue to cost for a long time—much more than surface travel. There has been nothing to show conclusively that vast hordes of business men will have to travel to

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all parts of the world after the war any more than they had to before.

Though vastly greater numbers of pleasure travelers will want to indulge in international travel, there is also nothing to indicate that they will be more able to do so than they have to date. Income taxes alone will take any marginal money the average man might have for pleasure travel, and certainly these taxes are not going to vanish like a bad dream with the signing of the armistice. A national debt of $100,000,000,000 or more means that John Q. Public will have his excess cash, if any, taken care of for more than two or five years after the war.

In the matter of international cargo, markedly lower operating costs are imperative if air transportation is to get any respectable share of even the so-called express type of shipment. True, these costs will be steadily lowered, but they can't be expected to drop miraculously over-night—or even within two years after the Armistice—to a level where they can approach competition with surface carriers.

Here again, air transport will have to be sold, and an idea of the size of the selling job can be gleaned from a recent survey by the Foreign Credit Interchange Bureau of its 215 members. Fully 66 percent reported their products were not suited to air transport; 23 said some of their products "might" be suitable for movement by air, 12 said their products did have air transport possibilities, and 5 reported that small quantities might be moved by air. It is notable that 90 percent replied they expected no change in credit terms through use of air cargo.

As to sales of passenger and cargo planes for export, the study shows little encouragement, the figure for the V-2 market being set at 100 craft valued at $20,000,000. Why so low? Well, that question can best be answered by a counter question: Just who is going to have the money to buy American planes? Exports of new commercial craft prior to the war were never large even by prewar production standards; with most nations further impoverished by the war there is no reason to believe many outlets can be provided.

These facts, too, should be borne in mind: Much of the prewar world provided markets only for our used aircraft. Since it is believed many of our military transports will be left in the countries where they are based at the war's end, this "second hand" market will be flooded for some time, thus delaying entrance by these nations in either the used or new plane market. Even if one assumes that purchasing power will be available through continuance of lend-lease, it must be remembered that money and reasons for travel must be on hand to create a market for planes.

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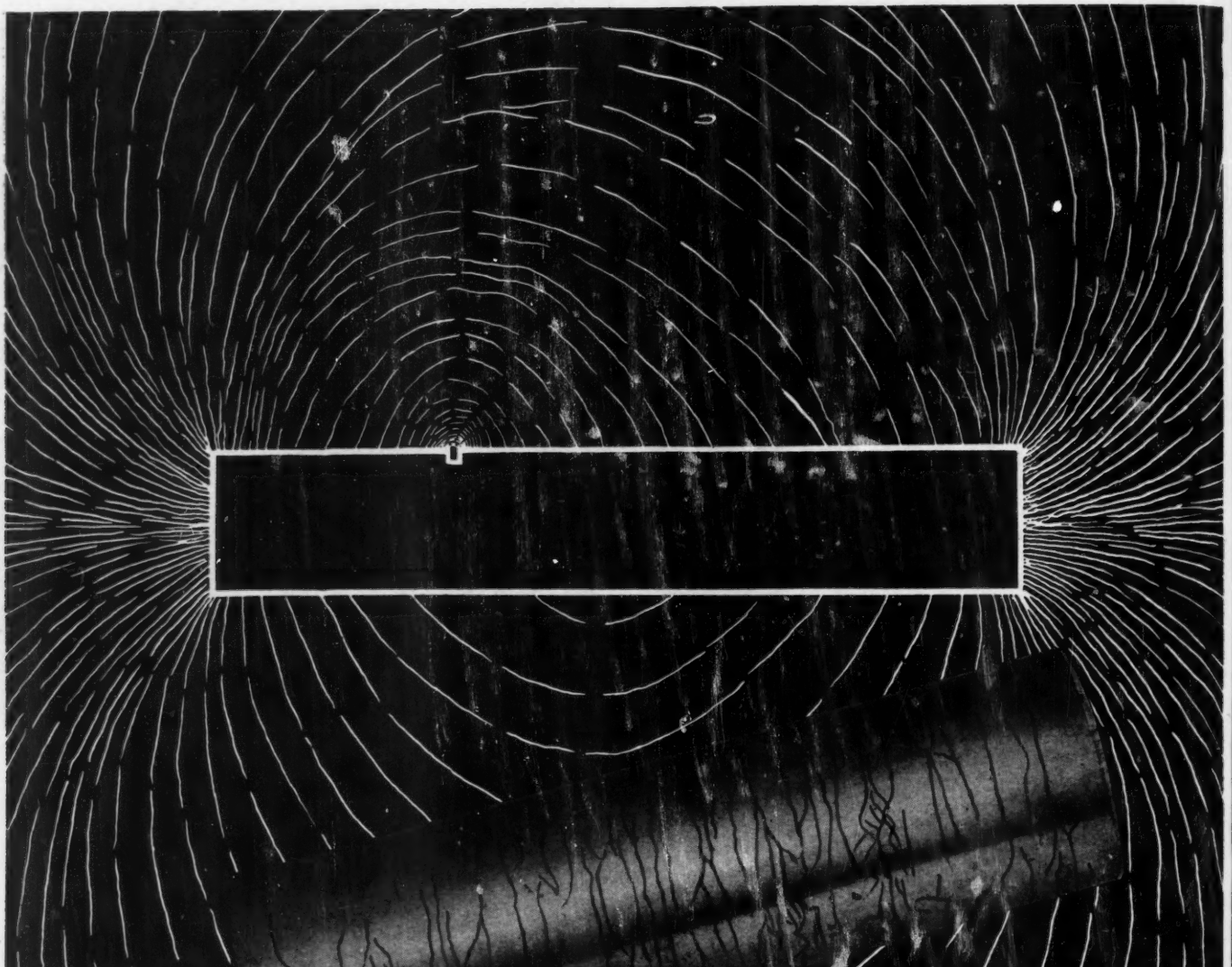

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In Europe, Africa, Asia, or wherever, transportation must be *sold* just as it has to be in the United States.

It is in the private, or personal plane, market that the study is at greatest variance with the more ebullient forecasters. For, according to the evidence, total production of 9,500 new planes—and 25 percent spares—valued at $84,000,000 (including a highly doubtful 2,500 helicopters) will saturate the V-2 market.

These craft are broken down as follows: 5,000 two-passenger planes valued at $9,500,000; 1,500 four- and five-place craft totaling $18,000,000 in value; 500 eight- to ten-place luxury or business executive craft at $30,000,000; and the 2,500 helicopters at $12,500,000.

Since the helicopter has been the subject of a dangerous flood of publicity it deserves special mention. In the first place, the men who are actually designing and building helicopters realize full well that they have many engineering problems to whip before the sales departments can hope to get a bead on even half the astronomic number of consumers predicted as the potential market. The helicopter will not be the craft for that vague "man in the street" for some time, because the simple but inescapable fact is that (1) ease of control and (2) inherent stability must be built into any craft for the average person. Certainly, neither of these two problems are insuperable, but those in the best position to know don't anticipate the helicopter's replacing—or even greatly supplementing—the automobile for a very minimum of five years. Thus the word "doubtful" is used. Before this five year period is over, the war may end still leaving development work to be done.

Then there is the ever-present matter of cost. Experienced aircraft producers judge prospective helicopter prices approximately as follows: With production at 500 per month, the required retail sales price would be $5,000 per unit; at 1,000 per month, the retail figure can be lowered to the $3,000-$4,000 range; and output of 1,500 per month could mean setting the price tag at a $3,000 top. It is obvious that with both engineering and distribution problems to be solved, the $5,000 price is the only answer for the V-2 market.*

Assuming that 2,500 helicopters could be made and sold, there would be but 7,000 fixed-wing craft to complete the projected V-2 market, or about 1,000 less than the light plane manufacturers alone produced in their best prewar year. It must be remembered, however, that at the beginning of the war there were 6,020 pleasure, 1,606 business-owned, and 5,780 non-scheduled commercial craft registered in this country—a total of 13,406 available planes in the personal plane group.

Since many of these planes have had hard wear in the gruelling CAP coastal patrol and courier services and in war training programs, a higher-than-normal attrition of 20 percent is applied, thus leaving an assumed 10,725 used planes in the hands of private owners, charter operators, and brokers at war's end. Adding the estimated 9,500 new craft gives 21,225 personal planes to be distributed over the two years.

That figure, it could be pointed out, is just over one plane for every 200 men in our projected 2,000,000-man air force. There is considerable evidence, however, that the air force men have been greatly over-worked as plane prospects. In the first place they are not, despite flying pay, getting rich. Most plane manufacturers figure that to be a real airplane prospect, a man must have an annual income of at least $4,000, which only colonels and over get in the Army. Obviously, there is little assurance that all or even a sizable portion of the 2,000,000 air force members will

* Also see article: "What Is the Helicopter's True Commercial Future?", page 116 this issue; and "Let's Be Calm About the Helicopter," page 114 Nov. AVIATION.

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return immediately to jobs that will put them in this income bracket.

In the second place, most air force men—like others in the services—are going to be automobile prospects before they become airplane prospects. Even if the immediate postwar personal plane has much more utility than it has today, these veterans will first buy cars and spend, as they did before the war, up to 20 percent of their incomes to operate and maintain them. The remaining 80 percent of that income (after the taxes the veterans will return to shoulder) will unlikely leave enough for the majority to buy and maintain aircraft.

In the third place, a surprisingly large number of today's air force men simply don't have the interest in aviation they are assumed to have. This is a factor which has been generally overlooked, but when surveys demonstrate that up to 25 percent of the men questioned show no interest in postwar flying of any kind, it has a definite bearing on market possibilities. Many men—including pilots—chose the aviation branch because they would "rather be in a flying army than a walking army." For others the novelty of flying has worn off and they will be content to return to their old ways of life before the war.

The over-all V-5 market, while still greatly under the estimates of the more optimistic, represents a considerably expanded outlet for American aircraft, calling for 2,925 commercial passenger craft, 2,875 cargo jobs, and the annual military demand of 6,000 planes. No attempt has been made to estimate personal plane requirements for this period, largely because design and production changes are unpredictable at this early date.

Three Private Flying Hurdles

Thus far, there have been three major restrictions to private flying: Lack of utility (due in part to over-regulation), price, and fear. Utility can be greatly increased by the development of airports and flight strips—constituting a long range project—and by the design of a practical roadable airplane or development of the helicopter. In the matter of price, there is every reason to believe the personal plane can eventually be produced at a cost comparable to the automobile, for actually a small plane weighs only a quarter to a half as much as the average low price car. Pertinent design, coupled with true mass production, will have to provide the answer.

To overcome the natural fear of the air, the personal plane must be designed and built so that anyone of normal intelligence not only can fly it with ease but also with assurance. The progress being made by personal plane manufacturers leaves little doubt that these restrictions will be overcome, but too many factors are beyond their control to warrant setting time limits.

An appraisal of the V-5 transport market can be broken down into two categories: The combination passenger-mail-cargo ship and the straight cargo craft. Requirements for the former may in turn be subdivided as follows: Domestic trunk lines, 700 planes at a total value of $175,000,000; domestic feeder planes, 1,200 for a total of $60,000,000; transocean planes, 250 for a total of $125,000,000; and sales for export markets, 775 planes to total $155,000,000. This sums up to 2,925 planes which, with 20 percent for spares costing $103,000,000, gives a total market value of $618,000,000.

See "Class" Traffic on Airlines

The domestic trunk line craft are expected to be of from 60 to 100 passenger capacity, with dual provisions for cargo. It is anticipated that they will serve three classes of traffic, which may be classed as commuter, deluxe, and super deluxe, roughly comparable to today's rail coach, Pullman, and extra-fare train. With increased operating efficiency and consequent greater plane utilization, the V-5 air transport market is forecast as consisting of 80 percent of first class rail traffic and 33 percent of the railroad coach and inter-city bus traffic, a level which airline operators feel they can reach by that time.

Feeder planes are expected to be largely of from 20 to 40 passenger capacity, with cargo space. While 1,200 appears a small number in view of the visionary forecasts, it should be remembered that the CAB is not going to award certificates of convenience and necessity to every and any applicant. Even a portion of those who do receive certificates will not be able to stay in business, thus they will have used equipment to put on the market. This 1,200 figure, while conservative, is believed to be logical because the feeder line, particularly in pick-up operations, offers greater opportunity to effect increased plane utilization, thus reducing the number required to give adequate service.*

Most experienced transport operators feel that 250 transocean planes—all of which will be in the 100,000-lb.-plus weight group—will adequately serve the traffic which they will be able to develop, for they cannot overlook the fact that surface vessels will still be sailing the seven seas, sailing them at a cost much lower than any that can be reached at that date by our transport aircraft.

The V-5 export market shows up two-and-a-half times greater than that estimated for V-2 operations, based on the fact that purchasing nations will be getting on their own feet financially or, perhaps, that the United States will continue to "cover" foreign markets, perhaps in a manner similar to the former German operations in Brazil. On a purely competitive basis, American planes will no doubt continue to dominate world markets, since today they have what is generally conceded to be a five-year lead over Great Britain's, which are considered their only serious competition in the postwar era.

The dollar value of the V-5 transport market is raised by the increase to 20 percent for spares; this must be so because of the larger number of larger planes involved.

The straight cargo plane market for the V-5 period can also be subdivided, with 1,850 domestic craft costing a total of $370,000,000, 250 transoceanic craft costing $125,000,000, and 775 for export sales totaling $155,000,000. Addition of 20 percent for spares gives a total dollar value of $780,000,000.

It is believed that the domestic cargo planes of the V-5 market will be of two types, 8-10 ton craft with cruising speeds of about 175 mph., able to give service at about 8c. per ton-mile, and approximately 20-ton craft, offering 4c. per ton-mile operations.

The number of planes estimated to be needed is based on the airline executives' belief that air cargo carriers can develop business making inroads up to 40 percent of the rail express business, 80 percent of the long distance parcel business, 10 percent of the l.c.l. rail freight, and 5 percent of the l.t.l. truck business.

Process of Supplementing

By comparison with visionary forecasts, the two- and five-year postwar markets projected by the study may at first appear overly pessimistic. In reality, however, they are felt to be realistically optimistic, for they represent increases over prewar business of as much as 500 percent. They represent, too, a sound and steady growth for an industry that will have to fight as hard for survival after the war as it did before. These markets do not envision air transportation supplanting, but rather supplementing improved and better coordinated highway, rail, and ocean transportation.

It is only in the 10-20 yr. period after the war that air transportation will make the serious inroads now dreamed of. Sound, steady growth up to that period may well make realities of such volumes of business as: more than 80 percent of the first class passengers traveling over 300 mi.—at rates reduced by 25-30 per cent; 80 percent of the first class mail going over 400 mi., with costs cut by half; and 40 percent of the railway express volume, with rates reduced 500 percent from present levels.

* Also see "The Feeder Airline's Place in Postwar America," page 116 Nov. AVIATION.